OIL REFINERY NEAR US

STUDY CASE OF SINOPEC-KPC OIL REFINERY IN GUANGDONG, CHINA
OIL REFINERY
OIL REFINERY
MECHANISM
MECHANISM

FRACTIONAL DISTILLATION
OF CRUDE OIL

fractional distilling column

straight-run gas

straight-run gasoline

straight-run naphtha

straight-run kerosene

straight-run light gas oil

straight-run heavy gas oil

straight-run residuum

crude oil

downcomer

bubble cap

vapor

liquid

vapor
SINOPEC-KPC JV OIL REFINERY IN GUANGDONG PROVINCE

- Initiation of the project
- Project Development
- Evaluation (Cost and Benefit)
- Solutions
INITIATIONS

- In 2004, Kuwait Prime Minister Sheikh Sabah Al-Ahmad Al-Jaber Al-Sabah met President Hu reached a consensus.

- Growing energy consumption in China

### Key Oil Data

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Production (kb/d)</td>
<td>2,504.7</td>
<td>2,773.7</td>
<td>3,009.2</td>
<td>3,268.9</td>
<td>3,637.0</td>
<td>3,736.6</td>
<td>3,819.2</td>
<td>3,800.2</td>
</tr>
<tr>
<td>Demand (kb/d)</td>
<td>1,842.4</td>
<td>2,321.3</td>
<td>3,289.8</td>
<td>4,626.1</td>
<td>6,730.2</td>
<td>7,609.3</td>
<td>7,801.9</td>
<td>8,045.8</td>
</tr>
<tr>
<td>Motor - gasoline</td>
<td>326.3</td>
<td>443.9</td>
<td>680.0</td>
<td>819.0</td>
<td>1,134.6</td>
<td>1,289.8</td>
<td>1,436.2</td>
<td>1,442.6</td>
</tr>
<tr>
<td>Gas/diesel oil</td>
<td>396.4</td>
<td>550.1</td>
<td>883.2</td>
<td>1,391.1</td>
<td>2,242.5</td>
<td>2,554.1</td>
<td>2,765.8</td>
<td>2,811.6</td>
</tr>
<tr>
<td>Residual fuel oil</td>
<td>517.7</td>
<td>614.5</td>
<td>674.0</td>
<td>706.6</td>
<td>774.0</td>
<td>758.6</td>
<td>590.7</td>
<td>516.0</td>
</tr>
<tr>
<td>Others</td>
<td>602.0</td>
<td>712.7</td>
<td>1052.6</td>
<td>1709.4</td>
<td>2579.0</td>
<td>3006.8</td>
<td>3009.2</td>
<td>3275.7</td>
</tr>
<tr>
<td>Net imports (kb/d)</td>
<td>-662.4</td>
<td>-452.4</td>
<td>280.6</td>
<td>1357.2</td>
<td>3093.2</td>
<td>3872.7</td>
<td>3982.6</td>
<td>4245.7</td>
</tr>
<tr>
<td>Import dependency</td>
<td>-36.0%</td>
<td>-19.5%</td>
<td>8.5%</td>
<td>29.3%</td>
<td>46.0%</td>
<td>50.9%</td>
<td>51.0%</td>
<td>52.8%</td>
</tr>
<tr>
<td>Oil in Total Energy Consumption</td>
<td>17.1%</td>
<td>16.6%</td>
<td>17.5%</td>
<td>22.2%</td>
<td>19.8%</td>
<td>18.8%</td>
<td>18.3%</td>
<td>17.9%</td>
</tr>
</tbody>
</table>

DEVELOPMENT

- Slow in progress until the Kuwaiti Oil Minister Sheik Ahmad Al-sabah pushed it.

- Proposed $6 billion joint venture with PetroChina Co. to build a 240,000 bpd (12 million tons/year) refinery and 1 million tons per year ethylene cracker in Nansha District in Guangzhou.

- JV partners set to changed to Sinopec
ADVANTAGES OF NANSHA

- 14 Large and Mid-sized Cities within 100km

- Existing Harbour

- Relatively distant to Guangzhou Urban Area

- Fresh Water Resources
DISADVANTAGES OF NANSHA

- Fragile Environment
- Environment Capacity
- Centre of populated cities
# COST AND BENEFIT

<table>
<thead>
<tr>
<th>Cost</th>
<th>Benefit</th>
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</thead>
<tbody>
<tr>
<td>Resettlement of Local Residents</td>
<td>Ease Guangdong Energy Demand</td>
</tr>
<tr>
<td><strong>Environmental Impacts</strong></td>
<td>Introduction of Advanced Technology</td>
</tr>
<tr>
<td>Time</td>
<td>Tax Revenue (almost $2billion)</td>
</tr>
<tr>
<td>Opportunity cost</td>
<td>Local Leakages or Cluster Effect</td>
</tr>
<tr>
<td>Real Estate</td>
<td></td>
</tr>
<tr>
<td>Lost Farm Land</td>
<td></td>
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# EMISSION SUBSTITUTION

<table>
<thead>
<tr>
<th></th>
<th>Huangpu Refinery</th>
<th>Nansha Refinery</th>
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</thead>
<tbody>
<tr>
<td>SO2 unit emission</td>
<td>14.8 tons / 10000 tonnes petrol production</td>
<td>3 tons / 10000 tonnes petrol production</td>
</tr>
<tr>
<td>SO2 Net Emission</td>
<td>-6035.88 tonnes</td>
<td>6000 tonnes</td>
</tr>
</tbody>
</table>

Wastewater reduction: 83.75 tonnes  
Chemical needed oxygen reduction: 81.5 tonnes

While a 240000 bpd capacity needs 7 million tons of fresh water annually
ENVIRONMENTAL IMPACTS

- SO2: 8481 tonnes Nox: 5509 tonnes, → Acid Rain
- TSP(Trisodium Phosphate Na3PO4): 2300 tonnes
  → eutrophication → Water Pollution
- GHGs EMISSION
- Other toxic gas:
  - PM2.5 → Smog
- Oil waste
- Smell
ENVIRONMENTAL IMPACTS

Cities around would bear the environmental cost
WHAT HAPPENED

The project was moved to Zhangjiang, Guangdong
## SCALE

<table>
<thead>
<tr>
<th></th>
<th>Zhanjiang</th>
<th>Nansha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Refinery Production</strong></td>
<td>300000 bpd</td>
<td>240000 bpd</td>
</tr>
<tr>
<td><strong>Ethylene</strong></td>
<td>1000000 tonnes</td>
<td>110000 tonnes (amended for environmental assessment)</td>
</tr>
<tr>
<td><strong>Investment</strong></td>
<td>59 billion yuan (~$10b)</td>
<td>35 billion yuan (~$6b)</td>
</tr>
<tr>
<td><strong>Carbon Emission in Construction</strong></td>
<td>4500 tons</td>
<td>10,000 tons</td>
</tr>
</tbody>
</table>
ADVANTAGES

- Lower Population Density
  (14m vs 60m)

- More Environment Capacity

- Larger Scale of Harbour
DISADVANTAGES

- Close the military base
- Distant to the market
- Less educated people
SOLUTION

For the Nansha development
- Increase the ratio of the tertiary industry, specializing in tourism and harbour logistics and avoiding polluting sources

Barriers
- GDP competition with Shenzhen
- Tax Revenue
- Short sighted local decision makers and residents
**SOLUTION**

Oil Refinery Zhanjiang
- Create heavy loading railway to PRD

**Barriers**
- It takes time to build
- Oil demand might decrease in the future
SOLUTION

Environment
- Incentives for Mitigation for Oil Refinery waste and pollution
- Increase consumer-automobile gas quality

Barriers
- Costs
- History of cheating
- No market requirement (not yet)
- No strict enforcement
THANK YOU