“SCG Chemicals…

...Chemicals Basics”
INDUSTRY VALUE CHAIN

SCG CHEMICALS AT A GLANCE
Starting from oil and gas industry

Primary Gas (Non-associated Gas)

Associated Gas

Crude Oil

Gas Well

Oil Well

Conventional non-associated gas

Sandstone

Tight sand gas

Gas-rich shale

Coalbed methane

Conventional associated gas

U.S. Energy

Land surface

Seal
Oil for chemicals

- Crude Oil
  - Petroleum Coke, Fuel Oil, Asphalt (20%)
  - Petroleum gas - e.g. LPG (3%)
  - Naphtha - Chemicals feedstock (6%)
    - Alternative outlet (upgrade to gasoline)
      - Gasoline (22%)
      - Kerosene/Jet Fuel (6%)
      - Gas oil or Diesel distillate (34%)
    - Heavy gas or Fuel oil (20%)
  - Petroleum Coke, Fuel Oil, Asphalt (9%)

Refinery
Two types of gas
Only wet gas is suitable for chemicals industry.

Dry Gas
- Methane: 95%
- 5% of Butane & Others, Propane, Ethane

Wet Gas
- Methane: 70-90%
- <5% of Butane & Others
- 5-15% of Ethane
- 5% of Propane
Gas for chemicals

- Methane
  - Fuel i.e. Power Plant
  - Feedstock for Methanol
- Ethane
  - Chemicals Feedstock
- Propane
- Butane
  - Heating LPG
  - Chemicals Feedstock
- Natural Gas Liquid (NGL)

Gas Separation Plant (GSP)

Not all natural gas fit for chemicals feedstock. Many are lack of ethane composition.
## Conventional Chemicals Feedstock

<table>
<thead>
<tr>
<th>Ethane</th>
<th>LPG</th>
<th>Naphtha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
<td><strong>Pros</strong></td>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>(+) Relatively cheaper feedstock</td>
<td>(+) Good yield of ethylene (C2) and propylene (C3)</td>
<td>(+) High product variety, 50-60% yield as by-product (non-ethylene, non-propylene)</td>
</tr>
<tr>
<td><strong>Cons</strong></td>
<td><strong>Cons</strong></td>
<td><strong>Cons</strong></td>
</tr>
<tr>
<td>(-) No product variety, only for ethylene (C2) production</td>
<td>(-) High price and limited supply in winter</td>
<td>(-) Relatively more expensive</td>
</tr>
<tr>
<td>(-) Subject to local availability, due to uneconomical bulk transportation</td>
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</tbody>
</table>

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Chemicals Chain

Feedstock
- Ethane
- LPG
- Naphtha

Process
- Ethane Cracker
- Naphtha Cracker

Product
- Ethylene (C2)
- Propylene (C3)
- Mixed C4
- Aromatics
  - Benzene (C6)
  - Toluene (C7)
  - Mixed Xylene (C8)
Ethylene chain (C2) .......Raw materials for polyethylene (PE) and PVC

- Polyethylene 60%
- PVC 11%
- Ethylene Oxide 14%
- Styrene Monomer 7%
- Others 8%
Four mains categories of Polyethylene (PE) and its characteristic

- HDPE
- MDPE
- LLDPE
- LDPE
Beside from resins production, more value can be added by compounding process

**Compounding = Resin + Coloring + Additive**

- **HDPE Pipe and fitting compound**
- **MDPE Roto molding compound**
- **HDPE Wire and cable compound**
Polyvinyl Chloride (PVC)

- Chlorine
  - H₂
  - Ethylene (C2)
  - Ethylene (C2)
- Caustic Soda
- Salt
- Water
- PVC Resin

PVC Resin → PVC Compound → Finished Product

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Chemicals Chain

Feedstock

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- Naphtha

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- Mixed C4
- Aromatics
  - Benzene (C6)
  - Toluene (C7)
  - Mixed Xylene (C8)
Propylene Chain (C3)

Raw materials for polypropylene (PP)

- Polypropylene: 65%
- Propylene Oxide: 8%
- Acrylic Acid: 4%
- Oxo Alcohol: 7%
- Acrylonitrile: 9%
- Cumene: 4%
- Others: 3%

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Polypropylene (PP) and its characteristic
High-value polypropylene resins and compound

- PP Medical
- PP Automotive
- PP Electrical appliance
Chemicals Chain

Feedstock
- Ethane
- LPG
- Naphtha

Process
- Ethane Cracker
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  - Mixed Xylene (C8)
Mixed C4

......Raw materials for butadiene (BD) and MMA

Mixed C4s → Butadiene (BD) → Synthetic Rubber (BR, SSBR)

Mixed C4s → MMA → Signboard → Auto Parts → LCD/LED TV
# New movements in chemicals industry

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<thead>
<tr>
<th>Process</th>
<th>Feedstock</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal-to-Olefins (CTO)</td>
<td>Coal</td>
<td>Ethylene (C2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Propylene (C3)</td>
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<td>Methanol-to-Olefins (MTO)</td>
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</tr>
<tr>
<td>Propane Dehydrogenation (PDH)</td>
<td>Propane</td>
<td>Propylene (C3)</td>
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</table>
Investments and Challenges in China

Methanol to Olefins (MTO)
• High investment
• Remote location, far away from demand
• Water supply availability
• Environmental concerns

Coal to Olefins (CTO)
• High investment
• Remote location, far away from demand
• Water supply availability
• Environmental concerns

Propylene Dehydrogenation (PDH)
• High feedstock cost during winter season due to heating demand

Inner Mongolia

Coastal Area
**Future chemicals development**

<table>
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<tr>
<th>Ethylene global supply</th>
<th>Propylene global supply</th>
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<td><strong>200 MT in 2020</strong></td>
<td><strong>140 MT in 2020</strong></td>
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- **Naphtha** 48%
- **Conventional Gas** 43%
- **Coal & Others** 5%

- **New shale gas crackers** 4%: Potential delay due to permit approval

- **72% liquid base = marginal price setter**

- **Naphtha** 47%
- **Coal & Others** 14%
- **Refinery** 25%

- **New gas cracker (PDH)** 14%

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SCG Chemicals At a Glance

Long Son Petrochemical (SCG 46%)
- Signed long-term feedstock agreement
- Signed land lease advance agreement (400 Hectares)
- Appointed financial advisor
- During bidding for engineering, procurement and construction contractor and securing necessary financing.

Chandra Asri Petrochemical
( SCG 30%)
- Signed long-term feedstock agreement
- Signed land lease advance agreement (400 Hectares)
- Appointed financial advisor
- During bidding for engineering, procurement and construction contractor and securing necessary financing.

Key Achievements
- Stabilize operations
- Refinancing
- Butadiene Project
- Synthetic Rubber Project
- Debottleneck Project
- Naphtha Procurement
SCG Chemicals Group
...over 60 companies & more than 5,000 employees

**Subsidiaries**
- CRACKER
  - Rayong Olefins
  - Map Ta Phut Olefins
- PE/PP
  - SCG Plastics
  - SCG Performance
  - Thai Polyethylene
  - SCG ICO Polymers
- PVC
  - Thai Plastics and Chemicals
  - Nawa Plastics
- SERVICE
  - Map Ta Phut Tank Terminal
  - REPCO

**SCG-Dow JV**
- LLDPE
  - Siam Polyethylene
- SM/PS
  - Siam Styrene Monomer
  - Siam Polystyrene

**SCG-Mitsui JV**
- PP Compound
  - Grand Siam Composites
  - Mitsui Advance Composite (Zhongzan)
- Film
  - Siam Tohcello

**SCG-MRC JV**
- MMA/CCS
  - Thai MMA
- C4 & BR/SBR
  - Bangkok Synthetics
- MELAMINE
  - Thai MFC

**Overseas**
- **INDONESIA**
  - (Complex) Chandra Asri Petrochemical
  - (PVC) PT TPC Indo Plastic and Chemicals
  - (Terminal) PT Siam Masapion Terminal
- **VIETNAM**
  - (PVC) TPC Vina
  - (Compound) Viet Thai Plaschem, Chemtech
- **USA**
  - (Technology) GTC

**Others JV**
- PO
  - MTP HPPO Manufacturing
- ELASTOMER
  - Siam Synthetic Latex
- SERVICE
  - Rayong Tank Terminal
- SERVICE