Strategy of China’s Players Amidst PVC Overcapacity

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- **Established Economic Information Center of the Ministry of Chemical Industry**
- Merged to establish CNCIC
- Transferred to an enterprise

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  - Member of NSTL (National Science and Technology Library)

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  - CNCIC Database including Chinese Petrochemicals and other commodity chemicals
  - CNCIC Price Index

- **Broad Industrial Communication Platforms**
  - China International Exhibition Center of Chemical Industry
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- Downstream
- Technology
- Regulations
- Import & Export
- Price trend

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- Industrial Chain Optimization
- Competitiveness analysis
- Industrial Layout Study
- Investment Opportunity Analysis
- Marketing Strategy Consulting

Strategy Planning
- Enterprise planning
- Overall planning for park
- Industrial planning for park
- Science & Technology planning
- Support for government

Engineering Consulting
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- Fund application
- Post-evaluation

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Publications

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China accounts for 43% of global capacity and 40% of demand.

Global and China PVC supply and demand balance, 2017

- In 2017, China is the largest PVC producer in the world, with a capacity of 23.9 Mt/y and output of 17.9 Mt.
- The average operating rate was 75%, similar to the world average level.

### Top 5 importing regions

<table>
<thead>
<tr>
<th>Country/region</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>18.2%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>14.2%</td>
</tr>
<tr>
<td>South Korea</td>
<td>14.1%</td>
</tr>
<tr>
<td>Hongkong</td>
<td>8.8%</td>
</tr>
<tr>
<td>Japan</td>
<td>6.8%</td>
</tr>
</tbody>
</table>

### Top 5 exporting regions

<table>
<thead>
<tr>
<th>Country/region</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hongkong</td>
<td>20.4%</td>
</tr>
<tr>
<td>Philippines</td>
<td>7.6%</td>
</tr>
<tr>
<td>Vietnam</td>
<td>6.5%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>5.6%</td>
</tr>
<tr>
<td>Tanzania</td>
<td>5.2%</td>
</tr>
</tbody>
</table>

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Under ‘Economy Normalization’, the growth of PVC demand is reduced to stable level. Is the new prosperity cycle coming?

Stop the welfare-oriented allocation of housing, and commercialize all residential house

4 trillion investment stimulation

Apparent Demand (Mt)

Impact of global financial crisis

Normalization of economy after the stimulation of real estate and infrastructure

A new prosperity cycle?
As PVC demand is growing faster than supply in 2017, PVC industry is expected to be resilient in 2018.

The average growth of demand was faster since 2012, and a new prosperity cycle is likely to happen.

Demand growth rate is expected to be 3.7%, whereas 2% in capacity towards 2021.
PVC Market – Demand

PVC demand is 17.8 Mt, 8.7% higher than 2016. 59% of PVC resin is converted to rigid product, and its consumption share increases over the past 8 years.

PVC consumption by application in China

- Around 60% of PVC are to produce building materials, downstream of real estate industry.
PVC consumption is positively correlated with house construction in China.

PVC consumption vs. house construction from 2003 to 2017

- Housing completed
- Housing under construction
- Housing started

China housing construction (floor space) / Million m²

- PVC consumption / Mt

R² = 0.97
R² = 0.95
R² = 0.93
R² = 0.97
PVC consumption is positively correlated with house construction and automobile industries in China

PVC consumption vs. house construction and automobile production from 2003 to 2017

- Housing completed
- Housing under construction
- Housing started
- Automobile production

China housing construction (floor space) / Million m²

Automobile production / Million

PVC consumption / Mt

R² = 0.97
R² = 0.95
R² = 0.93
R² = 0.92
R² = 0.93
R² = 0.97
Calcium carbide process is more commonly used in China

China’s PVC capacity by process, 2006 and 2017

- Calcium carbide process increased by 20% over the last decade
- 20.6 Mt/y and 3.3 Mt/y are produced from calcium carbide, and ethylene processes respectively, accounting for 86% and 14% of total capacity
In 2017, there are 62 PVC producers in China, 19 less c.f. 2015

### Capacity share of major PVC producers, 2017

<table>
<thead>
<tr>
<th>No.</th>
<th>Company</th>
<th>PVC capacity /kt/y</th>
<th>Share/%</th>
<th>Region</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zhongtai Chemical¹</td>
<td>2100</td>
<td>8.8%</td>
<td>Northwest</td>
<td>C</td>
</tr>
<tr>
<td>2</td>
<td>ChemChina²</td>
<td>1500</td>
<td>6.3%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Tianye Group</td>
<td>1400</td>
<td>5.9%</td>
<td>Northwest</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>Yihua Group³</td>
<td>1200</td>
<td>5.0%</td>
<td>-</td>
<td>C</td>
</tr>
<tr>
<td>5</td>
<td>Bohai Chemical⁴</td>
<td>1200</td>
<td>5.0%</td>
<td>North</td>
<td>E</td>
</tr>
<tr>
<td>6</td>
<td>Beiyuan Chemical</td>
<td>1100</td>
<td>4.6%</td>
<td>Northwest</td>
<td>C</td>
</tr>
<tr>
<td>7</td>
<td>Qinghai Salt Lake Industry</td>
<td>800</td>
<td>3.3%</td>
<td>Northwest</td>
<td>C</td>
</tr>
<tr>
<td>8</td>
<td>Junzheng Energy</td>
<td>700</td>
<td>2.9%</td>
<td>North</td>
<td>C</td>
</tr>
<tr>
<td>9</td>
<td>Xinfa Group</td>
<td>700</td>
<td>2.9%</td>
<td>East</td>
<td>C</td>
</tr>
<tr>
<td>10</td>
<td>China Salt Group⁵</td>
<td>530</td>
<td>2.2%</td>
<td>-</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>12700</td>
<td>53.1%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>23930</td>
<td>100.0%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- Top 10 producers account for 46.9% of China’s total capacity
- Capacity is mainly distributed in Northwest, North and East regions in China

**Note.** 1: Zhongtai Chemical and Shengxiong Energy; 2: Bluestar (Shenyang Chemical), New Materials (Dezhou Shihua, Hebei Shenghua, Henan Yuhang, Heilongjiang Haohua); 3: Xinjiang, Qinghai and Inner Mongolia; 4: Dagu Chemical, Lejin Bohai Chemistry; 5: Inner Mongolia Jilantai, Anhui Jinbang

© 2018 CNCIC Consulting. All rights reserved  C is calcium carbide process, and E is ethylene based process
Uneven geographical distribution of raw material, PVC resin and plastic products

Production of plastic products, PVC & calcium carbide by region in China, 2017

China's Production distribution in 2017 (Mt)

<table>
<thead>
<tr>
<th>Region</th>
<th>Plastic products</th>
<th>PVC</th>
<th>Carbide</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>14.9%</td>
<td>25.5%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Northeast</td>
<td>7.9%</td>
<td>2.1%</td>
<td>0.3%</td>
</tr>
<tr>
<td>East</td>
<td>28.4%</td>
<td>9.9%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Central</td>
<td>15.4%</td>
<td>7.3%</td>
<td>8.8%</td>
</tr>
<tr>
<td>South</td>
<td>21.8%</td>
<td>1.4%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Southwest</td>
<td>8.0%</td>
<td>6.7%</td>
<td>7.2%</td>
</tr>
<tr>
<td>Northwest</td>
<td>3.6%</td>
<td>47.1%</td>
<td>80.9%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

- Calcium carbide processes are mainly concentrated in the northern, central and western regions, where there are abundant and cheap electricity, coal resources
- Ethylene producers are mainly located near the coastal areas, where raw material transportation is more convenient
Uneven geographical distribution of raw material, PVC resin and plastic products…
…configures the transportation map of PVC resin in China today

Production of plastic products, PVC & calcium carbide by region in China, 2017
PVC Market – Profitability

PVC production became profitable in 2017

- PVC avg. price in China

- The PVC industry has been through an industry-wide loss in 2014 and 2015 due to economic downturn and ‘Environmental Protection Storm’, with avg. EBIT margin of -0.4% ~ -0.5%

- In 2016, the profit was lost by 27%, and became profitable in 2017

- From 2014 to 2016, producers, located in Xinjiang, Inner Mongolia, Shaanxi and Shanxi provinces, have better cost advantages and profitability
PVC production became profitable in 2017

PVC avg. price in China

PVC gross profit by production process in China
## Measures

The current status and corresponding measures for PVC industry in China

<table>
<thead>
<tr>
<th>Status quo</th>
<th>Measures</th>
<th>Value chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity of PVC is still in surplus</td>
<td>• Mitigate existing capacity and control new capacity</td>
<td>Supply</td>
</tr>
<tr>
<td>PVC demand in stable growth</td>
<td>• Enhance supply side reform</td>
<td>Supply/Demand</td>
</tr>
<tr>
<td>Mercury catalyst pollution in calcium carbide</td>
<td>• Strengthen clean production, accelerate R&amp;D, and use alternative route</td>
<td>Industry integration</td>
</tr>
</tbody>
</table>
### A: PVC status quo
- The market is stable but operating rate is low
- Assuming a demand growth of 5% and keeping capacity at the current level, it will take 2 years to cut the current surplus capacity

### B: Previous Phasing out
- During 2010-2017, PVC capacity addition or elimination was mainly market-driven
- For resource advantage producers (mainly coal), capacity was expanded by new calcium carbide units
- For resource scarce producers (mainly calcium carbide) and small scale PVC units, they have been phased out from the market

### C: Future Measures
Producers will be forced to phase out if,
- **Safety**: not located in chemical parks (or cluster zones) and not meeting GB 11655.1-2012
- **Environmental protection**: punished over 3 times due to violation of related regulations during 2013-2015; not having mercury waste water or waste acid treatment units; having low-mercury catalyst consumption higher than 1.5kg/t of product
- **Energy consumption**: energy consumption per ton of product does not meet restriction in GB 30527-2014. Indicators, such as carbon, pollutants emissions, should be strictly implemented

Phase-out mechanism should established for producers which,
- have shut down, partially shut down, suffered loss for over 3 years, or had more than 100% asset-liability ratio

Promote company reform and restructure
Measures – Mitigate surplus capacity

More surplus capacity will be phased out, due to constrains on carbon/pollutants emission, energy efficiency

PVC capacity status in China from 2010 to 2022

- In the past 8 years, **14.8 Mt/y** new capacity is added, and **8.2 Mt/y** has been eliminated, which are mainly from SME PVC units, due to weak cost competitiveness
- In 2017, China’s total capacity of caustic soda is 41.0 Mt/y, and the output is 33.7 Mt/y, with an average operating rate of 82%. High price of caustic soda results in more chlor-alkali capacity entering the market, leading to an addition of 1 Mt/y PVC capacity in 2018
Measures – Expand supply side reform

- Consolidate traditional applications, such as PVC pipe and profiled materials sectors, and explore market for PVC made of compounding ingredients to improve the product quality
  - PVC pipe
    - Encourage R&D in high-impact PVC, O-PVC and large-diameter PVC pipes
    - Utilize PVC pipelines in 1-2 cities for demonstration by combining with ‘sponge city’ and urbanization
  - PVC profiled materials
    - Increase the application of PVC doors and windows by promoting “plastics replacing aluminum”
    - Contribute to energy-saving and emission reduction
Measures – Expand supply side reform

● Explore new applications through technology innovation

  – Establish R&D centers to develop serialized, specialized and targeted PVC brands to meet end-use markets.

  – Promote CPVC pipe in the application of indoor fire sprinkler systems

  – Establish strategic alliances through the whole value chain of PVC to strengthen research on the compatibility of plastic additives, manufacturing technologies and equipment, to incubate and promote new end-use markets.

  – Promote “plastics replacing wood”, and encourage the development of PVC mould and PVC wood-plastic composites

  – Explore lifecycle management of PVC products, and strengthen research on recycle and reuse of PVC products to support the green development of PVC industry

CPVC: chlorinated PVC
Measures – Strengthen clean production

Related policies and key tasks for environmental conservation

**Related policies**

- Comprehensive Control Scheme for Mercury Pollution in PVC Production by Calcium Carbide Process (MIIT)
- Guidance on Solving Severe Overcapacity Problems (State Council)

**Key tasks**

**Strengthen ‘reduction’**

- Promote and implement BAT/BEP technologies, further improve the management of production and operation, extend the service life of low-mercury catalysts and reduce the consumption and emission of mercury
Measures – Strengthen clean production

Related policies and key tasks for environmental conservation

**Related policies**

- Minamata Convention on Mercury
- Comprehensive Control Scheme for Mercury Pollution in PVC Production by Calcium Carbide Process (MIIT)
- Notice on Strengthening Mercury Pollution Control in PVC Production by Calcium Carbide Process and related Industries (MEP)
- Cleaner Production Standard — Chlor-alkali industry

**Key tasks**

- Enforce ‘mercury-free’
  - Promote the transformation and upgrade of the PVC calcium carbide production, and confirm the blueprint of ‘Low-mercury, mercury-free’
  - Strengthen further R&D and application of low-mercury catalysts, recycle and reuse of mercury-free catalysts and construct mercury-free catalyst production lines
  - By the end of 2018, construct two 100kt/a demonstrative projects using mercury-free catalysts
Measures – Strengthen clean production

Related policies and key tasks for environmental conservation

**Related policies**

- The Norm of Energy Consumption Per Unit Product of PVC
- Cleaner production standard —Chlor-alkali industry

**Key tasks**

- **Further intensify the development mode of cyclic economy**
  - Encourage enterprises to relocate to high-end chemical industrial parks
Conclusions

PVC development trend in China

- Environment protection will affect the industrial structure
- New capacity release is under pressure
- Demand is gradually growing
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