CARE Conference
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Jacob Pittman,
Consultant, Nylon Intermediates
(281) 752-3229
jpittman@cmaiglobal.com
CMAI Is . . .

- Global petrochemical consulting firm for over 25 years
- Consultants from petrochemical industry
- Analysis Based On:
  - Price analysis and forecasting
  - Production capacities and costs
  - Trade patterns
  - Socio-political factors
  - Governmental regulation
  - Emerging technologies
  - Materials/feedstock supply
Where Are We Located?

- New York
- London
- Düsseldorf
- Shanghai
- Dubai
- Singapore
- Houston
CMAI Monthly Consulting Services

- Acetone
- Aromatics
- Asian Styrenics
- C4 & Elastomers
- Chlor-Alkali
- European Aromatics
- Europe/Middle East Olefins & Derivatives
- Global Fibers & Feedstocks
- Global Plastics & Polymers
- Methanol
- Monomers
- Asian Olefins
- Asian Plastics & Polymers Weekly
<table>
<thead>
<tr>
<th>CMAI Annual Analyses</th>
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<tbody>
<tr>
<td>Benzene</td>
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<tr>
<td>Cumene/Phenol &amp; Polycarbonate</td>
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<tr>
<td>Styrene</td>
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<td>PS/EPS</td>
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<tr>
<td>Butadiene</td>
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<tr>
<td>Butylenes</td>
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<tr>
<td>Chlor-Alkali</td>
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<tr>
<td>Vinyls</td>
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<tr>
<td>Soda Ash</td>
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<tr>
<td>Light Olefins</td>
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<tr>
<td>Polyolefins</td>
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<tr>
<td>EO/EG</td>
</tr>
<tr>
<td>Methanol</td>
</tr>
<tr>
<td>Nylon &amp; Feedstocks</td>
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<tr>
<td>Xylenes &amp; Terephthalates</td>
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<tr>
<td>Terephthalates &amp; Polyester</td>
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<tr>
<td>Toluene &amp; Mixed Xylenes</td>
</tr>
</tbody>
</table>
Proprietary Services

- Feasibility studies
- Project appraisals
- Post project audits
- Strategic planning development
- Mergers & acquisitions
- Presentations
- Expert witnesses
Outline

• Plastics, Energy, Hydrocarbons
  – What’s oil got to do with it?
• Relationships between oil and plastics
  – How do I apply this?
• Conclusions
  – Do the math!
U.S. Consumption of Energy and Petrochemical Production (Oil Equivalents)

- **Domestic Supply**
  - Oil 37%
    - OPEC Others
  - Gas 85%
    - Canada & LNG
  - All others 100%

- **Average 71%**

Source: International Energy Agency and CMAI Analysis
U.S. Petrochemicals

- Oil: 20 MM BPD
- Gas: 60 B Cubic Feet/day
- Refining: Transportation & Heating Fuels
  - Naphtha Gas Oil: 93%
  - Methane (Fuel Gas): 7%
  - Ethane, Propane, Natural Gasoline, Butane: 95%

- Methane: 95%
- Ethane, Propane, Natural Gasoline, Butane: 5%
Why Do Oil & Gas Matter to Plastics?

- Petrochemicals are the source of raw material supply
  - Plastics are just organized hydrocarbons
- Energy demand establishes floor prices for petrochemical feedstocks
  - 62% of U.S. energy is supplied by Oil & Gas
- Where does it come from and where does it go?
World Crude Oil Production and Usage

Crude Oil Supply
- U.S.: 35%
- CIS: 6%
- OPEC: 13%
- Other: 4%
- China: 7%
- North Sea: 7%
- Middle East: 20%
- Europe: 25%

Crude Oil Demand
- U.S.: 35%
- CIS: 8%
- OPEC: 5%
- China: 7%
- North Sea: 5%
- Middle East: 20%
- Europe: 25%
U.S. Crude Oil Supply and Demand

Petroleum Supply

- Natural Gas Liquids: 8%
- Alaska: 4%
- Federal Gulf of Mexico: 6%
- Other Lower 48: 15%
- Net Imports: 60%

Petroleum Demand

- Motor Gasoline: 44%
- Jet Fuel: 8%
- Distillate Fuel Oil: 20%
- Residual Fuel Oil: 4%
- Other Oils: 24%
- Other: 7%
- Other Lower 48: 15%

Source: U.S. Energy Information Administration
U.S. Natural Gas End Uses
(20,495,108 MMCF)

Residential 23.3%
Electric Power 26.1%
Industrial 35.8%
Commercial 14.7%
Vehicle Fuel 0.1%

Source: U.S. Energy Information Administration
Electric Power Generation by Fuel Type (2005)

- **Coal**: 49.5%
- **Natural & Other Gas**: 18.9%
- **Petroleum**: 3.0%
- **Nuclear**: 19%
- **Other Renewables**: 2.3%
- **Hydroelectric Conventional**: 6.6%

Source: U.S. Energy Information Administration
Relationship of Oil & Plastics

• If plastics come from oil (hydrocarbons) can baseline value relationships be developed?
  – Yes
$/kg ratio to Crude Oil

($/Ton_{polymer} per $/Ton_{Crude})

Ratio (Polymer $/ton to Crude $/ton)
$/kg ratio to Crude Oil
($/Ton\text{polymer} \text{ per } $/Ton\text{Crude})

Range = +/- 1
Standard Deviation

Polypropylene

Singapore ♦ Shanghai ♦ New York ♦ Houston ♦ London ♦ Düsseldorf ♦ Dubai
$/kg ratio to Crude Oil
($/Ton_{polymer} per $/Ton_{Crude}$)

Ratio (Polymer $/ton to Crude $/ton)

2002 2003 2004 2005 2006 2007

- Nylon
- Polypropylene
- Polyester
- HDPE
Establishing a Floor Price

• Since we are comparing hydrocarbons substitutions shouldn’t we also look at the relationship on an energy (Btu) basis?
  – Yes, the laws of thermodynamics still apply, consuming less hydrocarbons is ecologically preferable to consuming more
  – Lowest value in concept is a products fuel value (plastics are just organized hydrocarbons)
    • Hydrocarbons ↔ Energy
    • Hydrocarbons ↔ Plastics
    • Plastics ↔ Energy
Price and Intended Use
(Approximate Q107)

<table>
<thead>
<tr>
<th>Btu per Pound</th>
<th>Dollars Per Pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpet</td>
<td>Energy Content, $/Btu</td>
</tr>
<tr>
<td>5,000</td>
<td>0.25</td>
</tr>
<tr>
<td>10,000</td>
<td>0.05</td>
</tr>
<tr>
<td>15,000</td>
<td>0.15</td>
</tr>
<tr>
<td>20,000</td>
<td>0.35</td>
</tr>
<tr>
<td>25,000</td>
<td>0.55</td>
</tr>
<tr>
<td>30,000</td>
<td>0.75</td>
</tr>
<tr>
<td>35,000</td>
<td>0.95</td>
</tr>
<tr>
<td>40,000</td>
<td>(0.05)</td>
</tr>
<tr>
<td>45,000</td>
<td>(0.25)</td>
</tr>
</tbody>
</table>

Singapore  Shanghai  New York  Houston  London  Düsseldorf  Dubai
Fitness for Use

• Why do different hydrocarbon forms (oil, gas, coal, etc.) have different prices?
  – Fitness for use via systems economics
    • Capital, operations, environmental, conversion efficiencies

• There are not adequate systems available for thermal recycling
How Do I Determine Market Price For My Product?

1. Sell some (A lot actually)
2. Estimate vs. available alternatives
3. Discounted Ratio vs. Oil
   - Deduct for less than prime grade; quality, delivery, terms, etc.
Estimating vs. Available Alternatives

• Obtaining estimated prices
  – Trade magazines publish prices that are high relative to the market and prices rarely move with short term price changes

• Industry Reports (CMAI)
  – Report prices are less expensive than bad decisions!
  – Good indicators of the market (contracts often tied to these reports)
  – Large buyers typically buy at a discount
Polypropylene Price Ratio to Crude

Virgin price typically falls within this range.

Polymer, $/lb

Crude $/barrel
Polypropylene Price Ratio to Crude

Virgin price typically falls within this range.

High/Low Price Ratio

Price at Avg. Margin

High/low PP Price

Crude Price

PP Market Price

Hurdle Price
How Do I Use This Information?

Go/No-Go Evaluations

• Maximum ratio to crude $/ton = Highest price obtainable for virgin polymer (not likely sustainable)
  – $60 \times 7.3 \text{ Bar.} \times \frac{3.9}{\text{ton}_{oil}} \text{ ton}_{p} = \frac{$1,708}{\text{ton}_{p}} = \frac{0.77}{\text{lb.}_{poly}}$

• Minimum ratio to crude $/kg = Lowest price virgin material is likely to be supplied to the market
  – $60 \times 7.3 \text{ Bar.} \times \frac{3.1}{\text{ton}_{oil}} \text{ ton}_{p} = \frac{$1,344}{\text{ton}_{p}} = \frac{0.61}{\text{lb.}_{poly}}$
Polypropylene Price Ratio to Crude

Virgin price typically falls within this range.

$0.70/lb.

Margins near middle of range.

High/Low Price Ratio

Price at Avg. Margin

High/low PP Price

PP Market Price

Crude Price

Hurdle Price
Establishing Hurdle Price

$0.42/lb.  Feedstock cost
$0.05/lb.  Processing (grinding, cleaning, packaging, etc.)
$0.02/lb.  Shipping
$0.01/lb.  Overhead and other
$0.50/lb.  Total delivered to customer cost

15%  Target margin

$0.57/lb.  Hurdle Price
Polypropylene Price Ratio to Crude

- High/Low Price Ratio
- Price at Avg. Margin
- High/low PP Price
- PP Market Price
- Crude Price
- Hurdle Price

Polymer, $/lb vs. Crude $/barrel

- $0.70/lb.
- $0.57/lb. Hurdle price
Estimating Actual Recycled Price

$0.70/lb.  Published Price
- $0.02/lb.  Less 2% for indexing to reach actual price
- $0.07/lb.  Less 10% for recycle delta to virgin price
$0.62/lb.  Total delivered to customer cost

Margin at $0.62/lb. = 24%, Not bad but... what happens when virgin margins go to bottom of range?
Polypropylene Price Ratio to Crude

Polymer, $/lb vs. Crude $/barrel

- PP min
- PP max

$0.61/lb.

Price at Avg. Margin

High/Low Price Ratio

High/low PP Price

PP Market Price

Crude Price

Hurdle Price

Singapore ♦ Shanghai ♦ New York ♦ Houston ♦ London ♦ Düsseldorf ♦ Dubai
Estimating Actual Recycled Price

$0.61/lb. Virgin price with low margins in chain
- $0.01/lb. Less 2% for indexing to reach actual price
- $0.06/lb. Less 10% for recycle delta to virgin price

$0.54/lb. Total delivered to customer cost

Margin at $0.54/lb. = 8%
$0.61/lb. Virgin price & $0.57/lb. Recycled price

$0.57/lb. Hurdle price

$56 per barrel
Do The Math!

• Challenge your assumptions!
  – Have a non vested party challenge your assumptions (be careful who you ask!)
    • You told your wife she looked nice in that dress
    • Your mother told you that you could be President
    • Your friends said she would go out with you
Conclusions

• Polymer prices track crude oil
• Value is determined by properties
• Accurate math performed on bad assumptions yields a bad assessment
  – Do the Math!!!
    • Check your work
    • Have someone else check your work and assumptions
    • Conventional wisdom is often wrong
Providing high quality, client-focused services directed towards developing valuable relationships for now...

and in the future

Thank you for your time