SBS Supply Outlook

Rocky Mountain Pavement Preservation Partnership

October 29, 2008

Presented by: The Association of Modified Asphalt Producers

DeWitt & Company

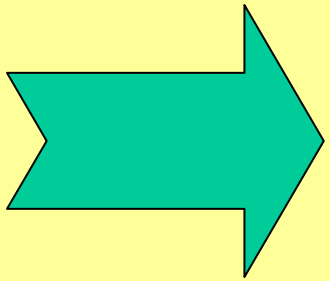
The Association of Modified Asphalt Producers

Why is SBS Currently in Short Supply?

- Styrene-Butadiene-Styrene (SBS) polymer capacity is not short
- Shortage of raw materials
- **Ethylene production is the problem**

Why is Ethylene Production the Problem?

Ethylene

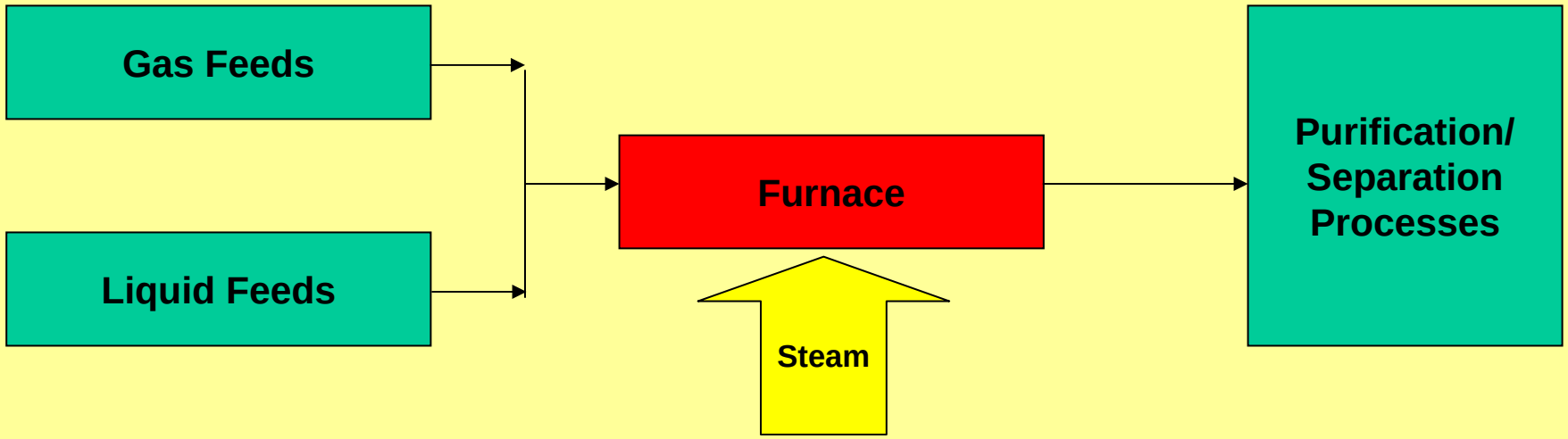


- **By-products of Ethylene Production**
  - Styrene
  - Propylene
  - **Butadiene**
  - Isoprene
  - Pentadiene
  - Cyclopentadienes
  - Aromatic Resin Formers
  - Isobutylene
  - Amylenes
  - Hydrogen
  - Benzene

Ethylene & Butadiene Market Comparison

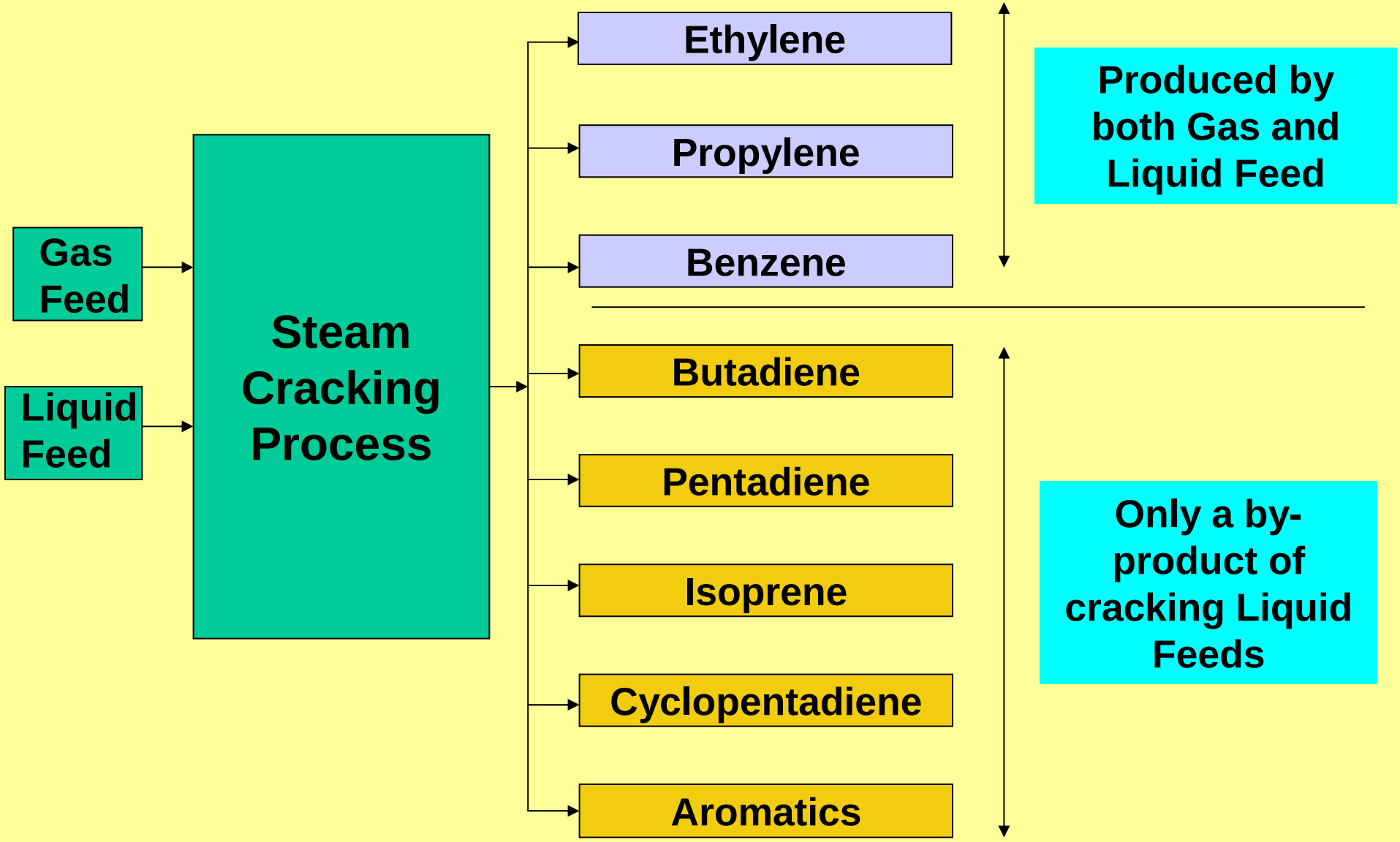
- **Ethylene Market**
  - 120 million tons per year
  - Primary use – packaging materials
    - Plastic wrap
    - Trash bags
    - Milk jugs
- **Butadiene Market**
  - 14 million tons per year
  - Primary use – tires (70%)
  - Multiple other automotive and durable good uses
  - SBS polymer for asphalt (6%)

How Is Ethylene Made?



- Basic ethylene production technology is called a steam cracking process
  - Process heats feed up to 1700 degrees, then injects steam that cracks the molecules
  - Cracker unit cost $2 billion
- Choice between gas feeds like ethane, propane and butane and liquid feeds like naphtha and gas oils.
- Output is a mixture of ethylene and other products
- Requires a downstream purification processes to separate products

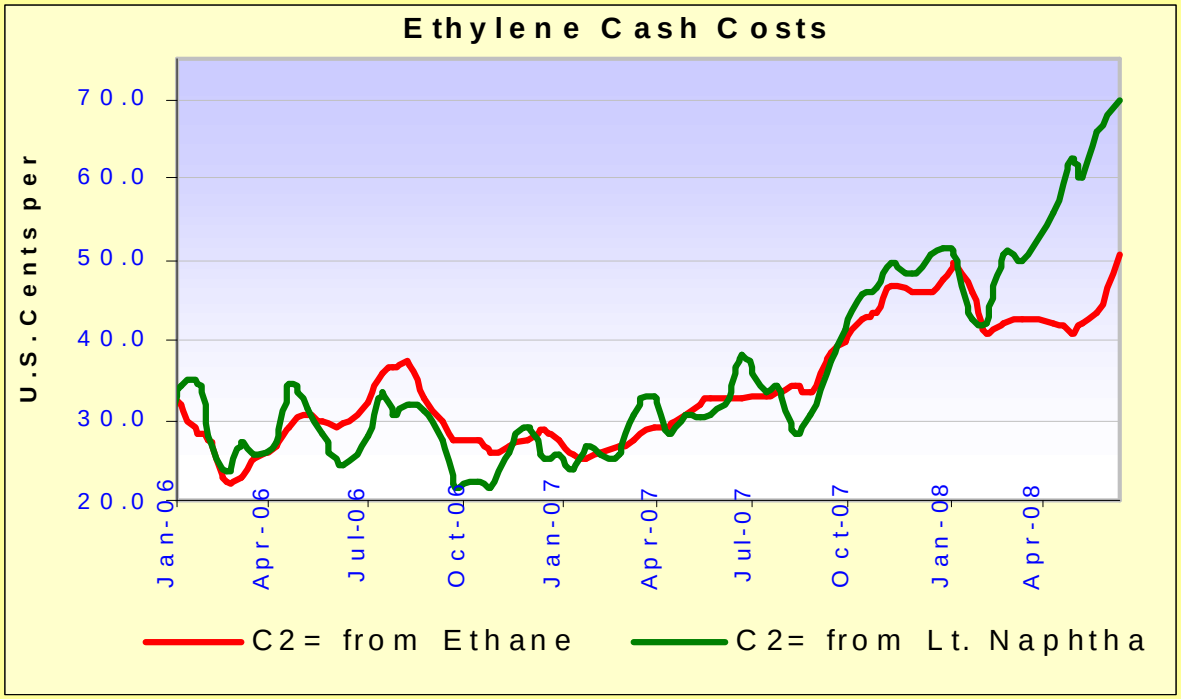
What's Important to Know About Ethylene Production



Choosing Feeds to Produce Ethylene

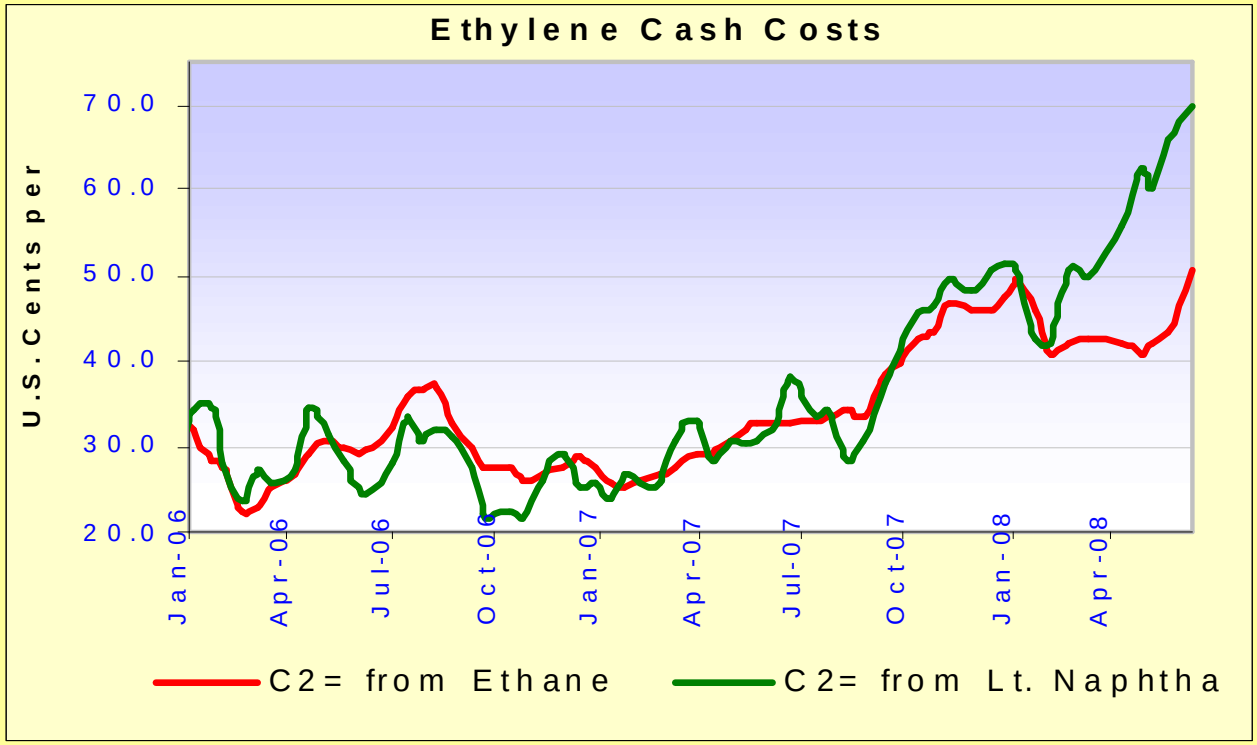
- **Each producer runs an economic model**
- **Feed availability and costs for the producer at their location**
  - Yield of each feed – varies considerably
  - Demand for each product
  - Alternatives to buy versus make that product
- **Ethylene and propylene are the prime products**
  - Evaluate netback of all products
  - Liquid feeds generally produce 15:1 ethylene to butadiene
  - Economic impact of butadiene is not large
  - Based on the conditions producers set a feed slate for the “Cracker”
  - Butadiene shortage is not a primary consideration for feed slate

Model Output



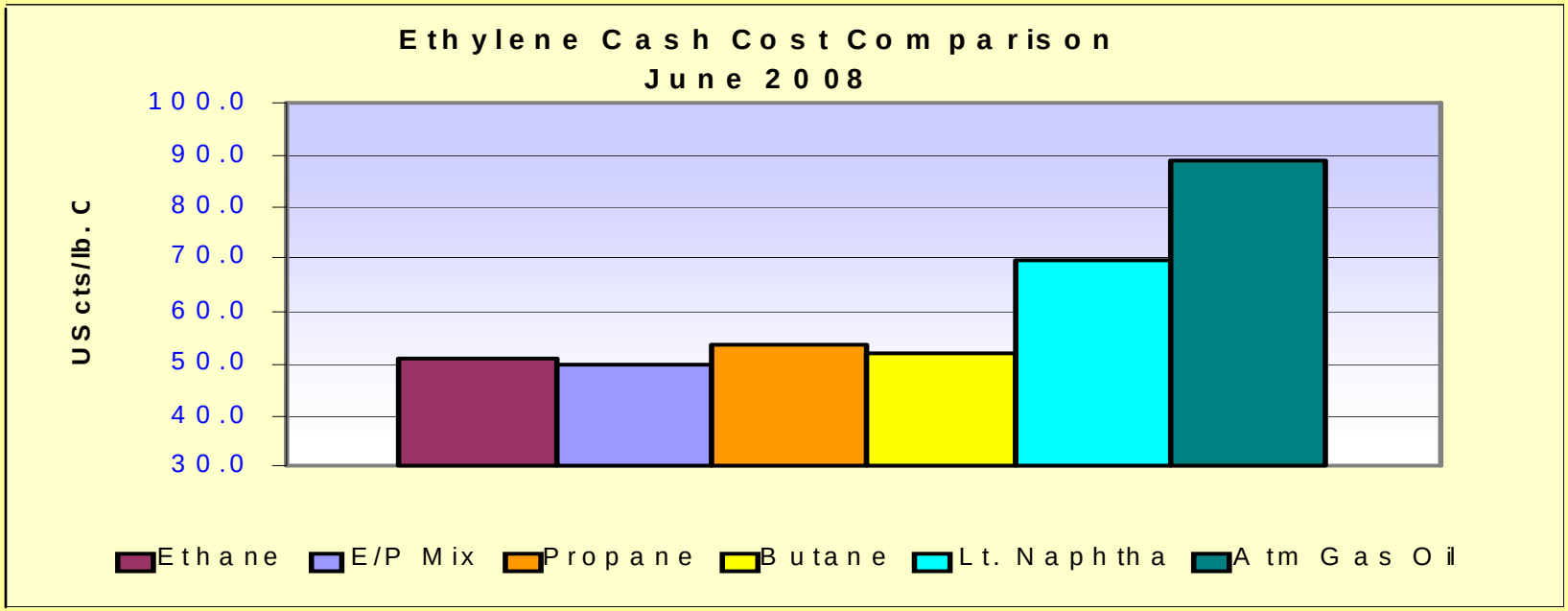
- Liquids are always in the slate due to the facilities being built to be liquid crackers
- Crackers modified in the 80's to be flexible
- Flexibility depends on producer, but varies from ~10% to ~50%
- Producing 3-5 million pounds a day a few pennies makes a big difference

What's Changed



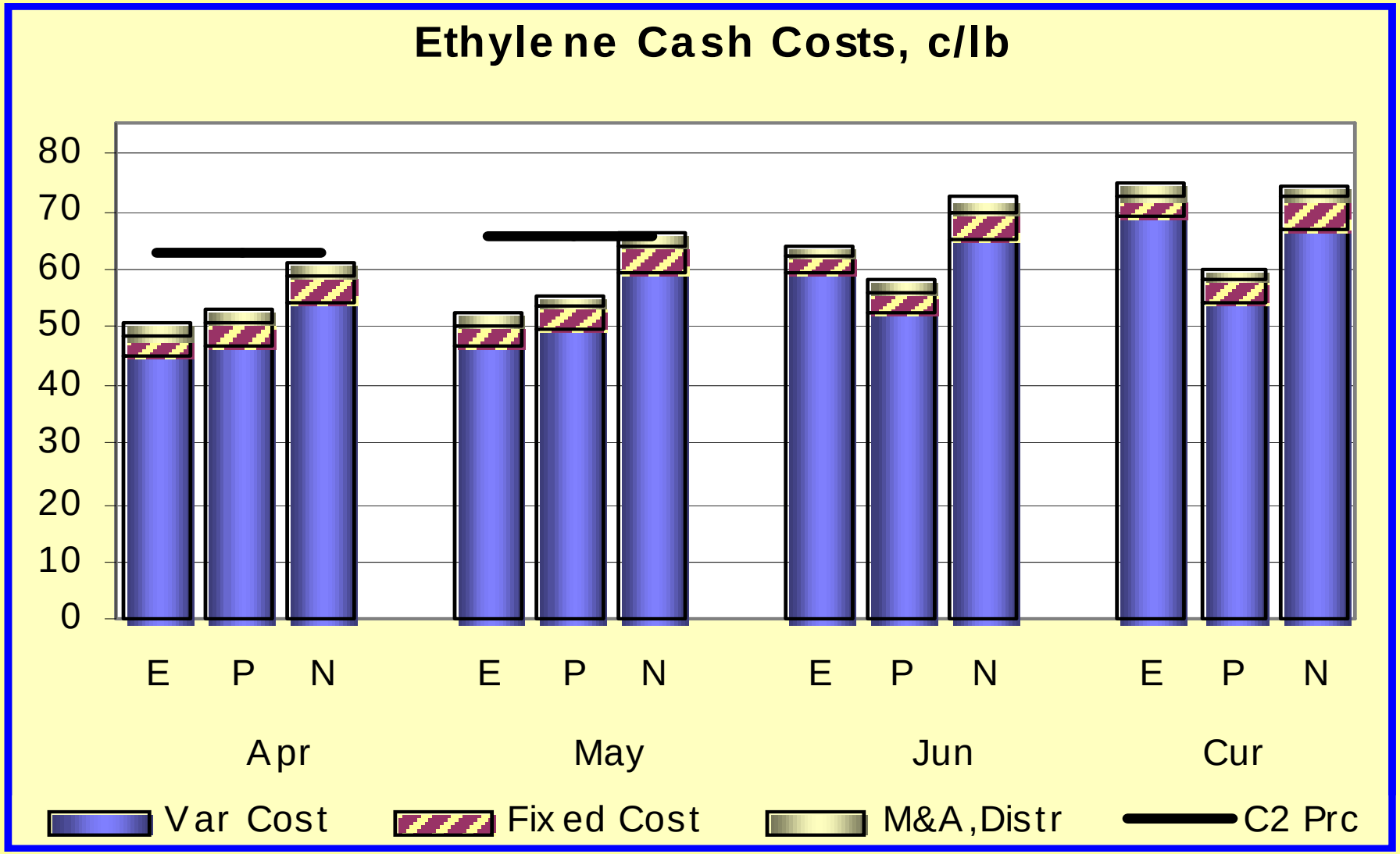
- **Structural change - natural gas producers installed facilities to separate ethane**
  - **Ethane higher value than natural gas**
- **Ethane prices didn't increase with the crude oil run-up**
- **Economic incentive to run more ethane feed**

What's Changed



- DeWitt estimates that the 1Q cracking slate went 10% lighter vs 2007 starting in February
- 2Q2008 slate has moved even lighter; possibly another 10-20%
- Incentives so great that teams of engineers are working on putting more gas into the cracking slate on a crash basis

Today



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Supply Issues Today

- Naphtha(liquid) cracking economics have improved, while ethane(gas) gotten worse.
- Ethylene producers have chosen to crack less ethane and more propane and butane for now – replaced gas with gas.
- Propane makes sense as it has a higher yield of propylene, which is short
- Slowing economy raises the spector of less ethylene production
- Next month ?

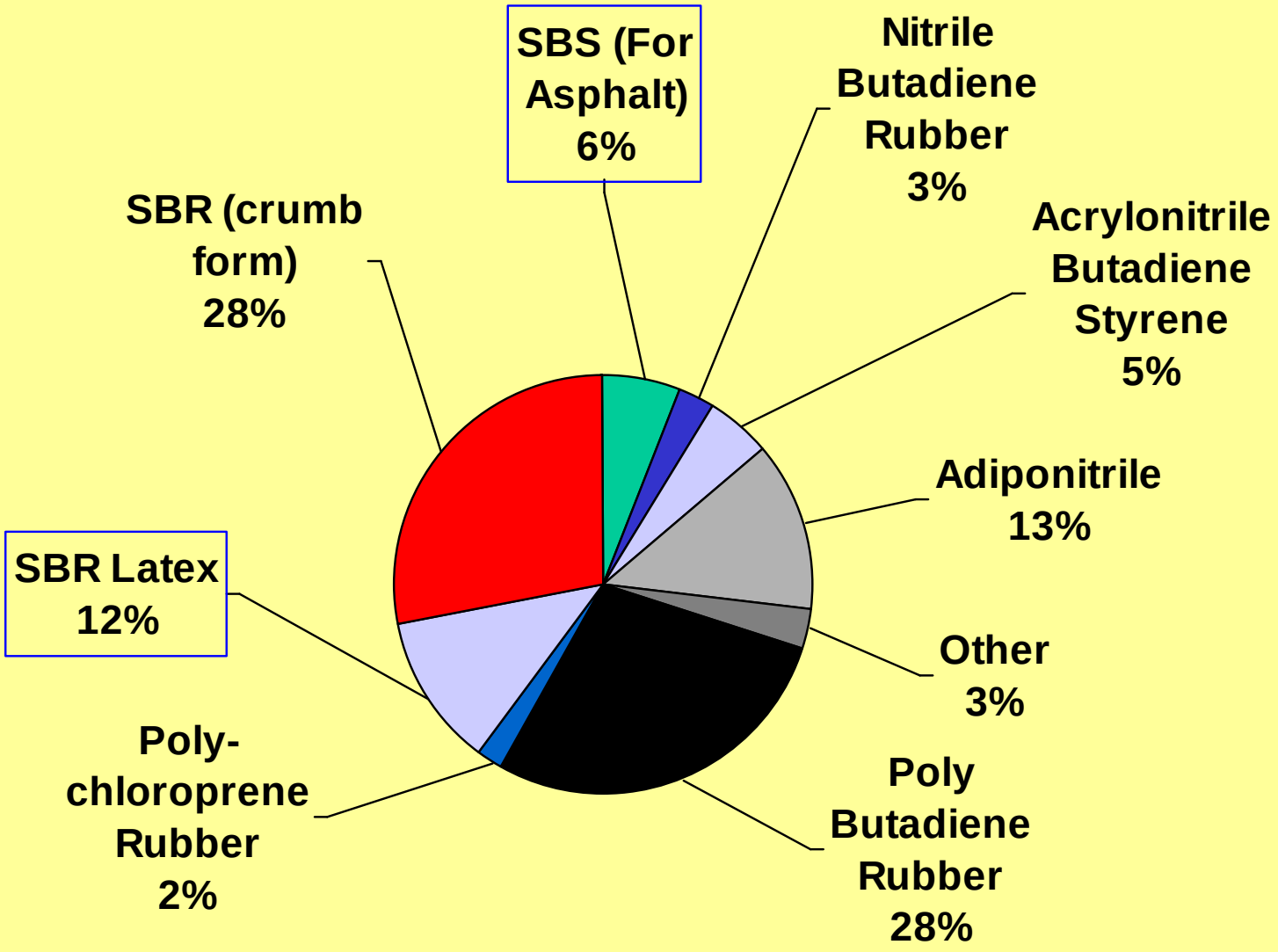
Ethylene General Trends

- **Significant ethylene capacity additions in Middle East and Asia**
  - Most of the Middle East is gas cracking
  - Most of Asia is liquid or naphtha cracking
- **Little to no capacity additions in Western World**
- **Naphtha is short globally and expected to priced higher like gasoline until more refineries are built ~2012**
- **New trend for ethylene units outside of US to be more flexible to be able to run more gas feeds**
  - Historically have been naphtha crackers
- **Expect more flexible cracking; hence, more variable Butadiene supply**

Butadiene (Bd) Supply

- **Globally tight due to lighter cracking and higher demand**
  - 2008 Bd supply estimated at 75-85% of 2007
- **New Bd and ethylene capacity due on-stream in Asia**
- **Expected capacity utilization to be lower than 90% for the foreseeable future**
- **Regional differences**
  - US crude Bd supply tight due to light cracking in first half
  - US has excess purification capacity and buys crude Bd from Europe to fill capacity
  - Europe tight on supply due to somewhat lighter cracking; thus, less crude Bd to export to US
  - New Asian capacity needs to catch-up with demand

North American Butadiene Consumption



What Factors Will Influence Supply?

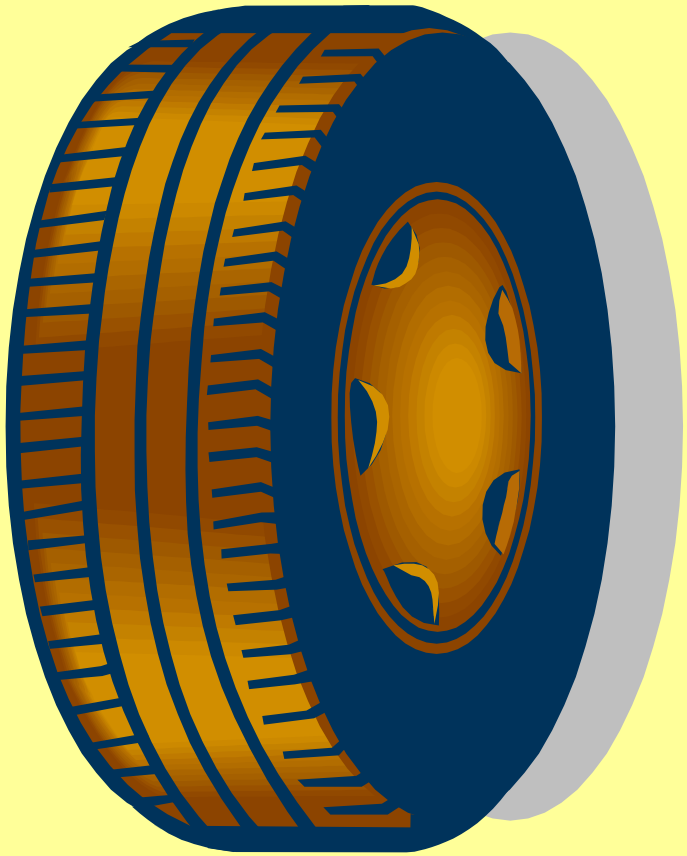
Positive

- **New capacity**
- **Bd pricing itself out of some applications**
- **High gas prices:**
  - Less driving mean fewer replacement tires
  - Smaller vehicles/smaller new car tires
- **Slowing economy; less growth**

Negative

- **Higher natural rubber prices driving consumers to synthetic rubbers based on Bd**
- **Lighter cracking**
  - Higher naphtha prices
  - Structural change in US ethane market
- **Low cost gas-based ethylene capacity coming on-stream in Middle East.**

Tire Demand Data



- New Tire Demand
  - June vehicle production down 8% and falling
  - Vehicle production skewed towards smaller vehicles
  - Tire demand could be down over 12%
- Replacement Tires
  - Higher gas prices are reducing miles driven
  - Expect reduced tire demand over time
  - May take 3-6 months to play out.

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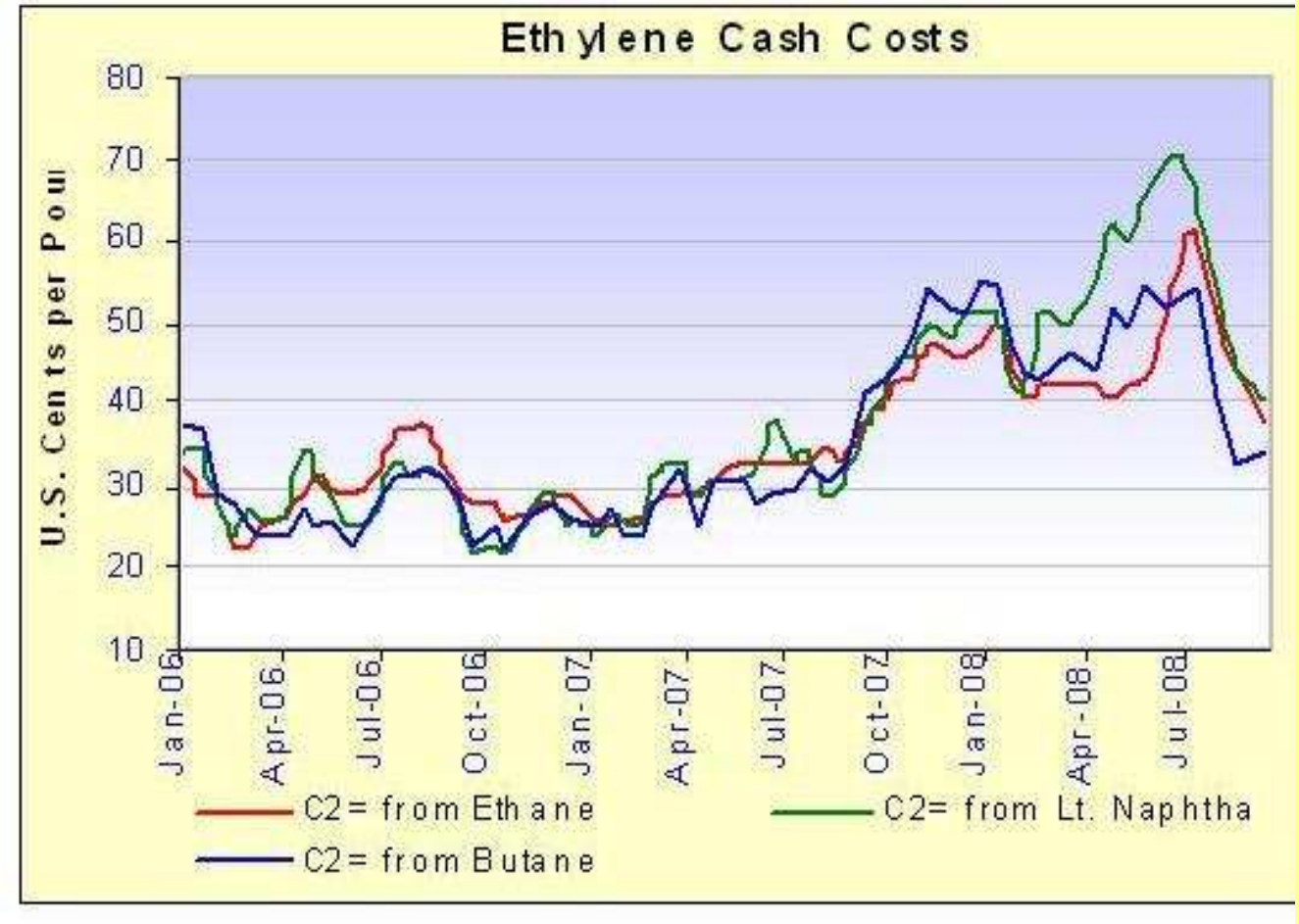
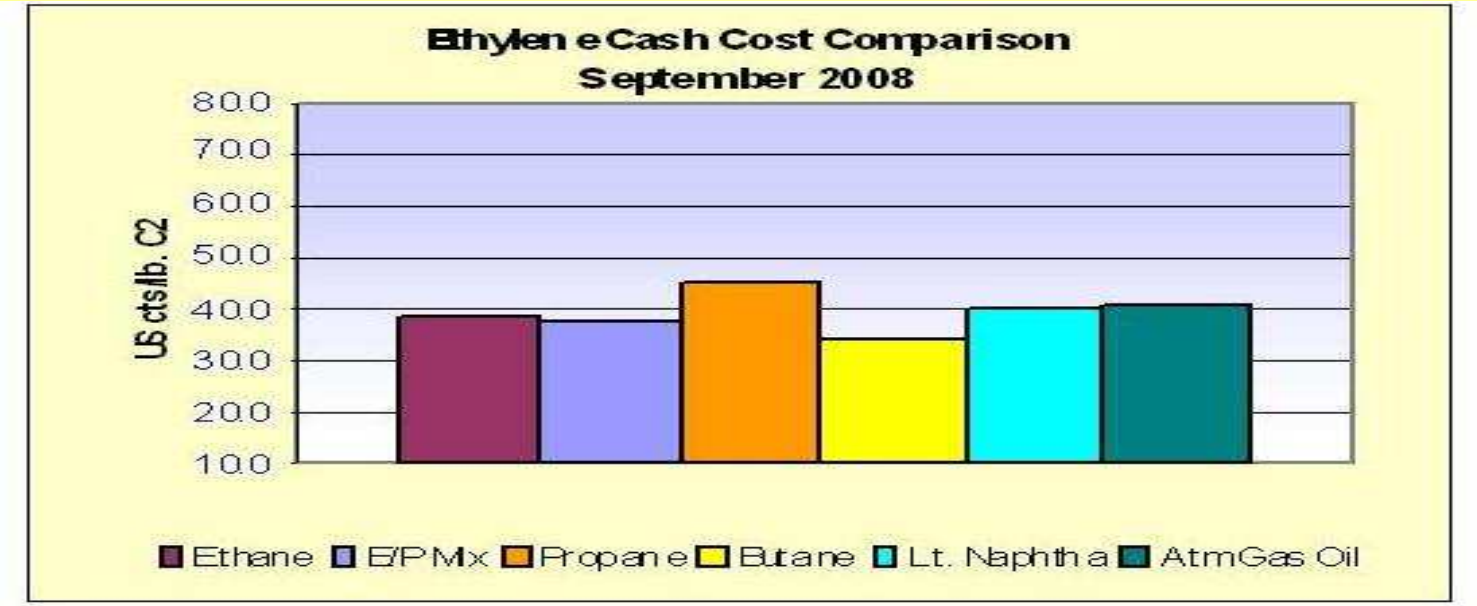


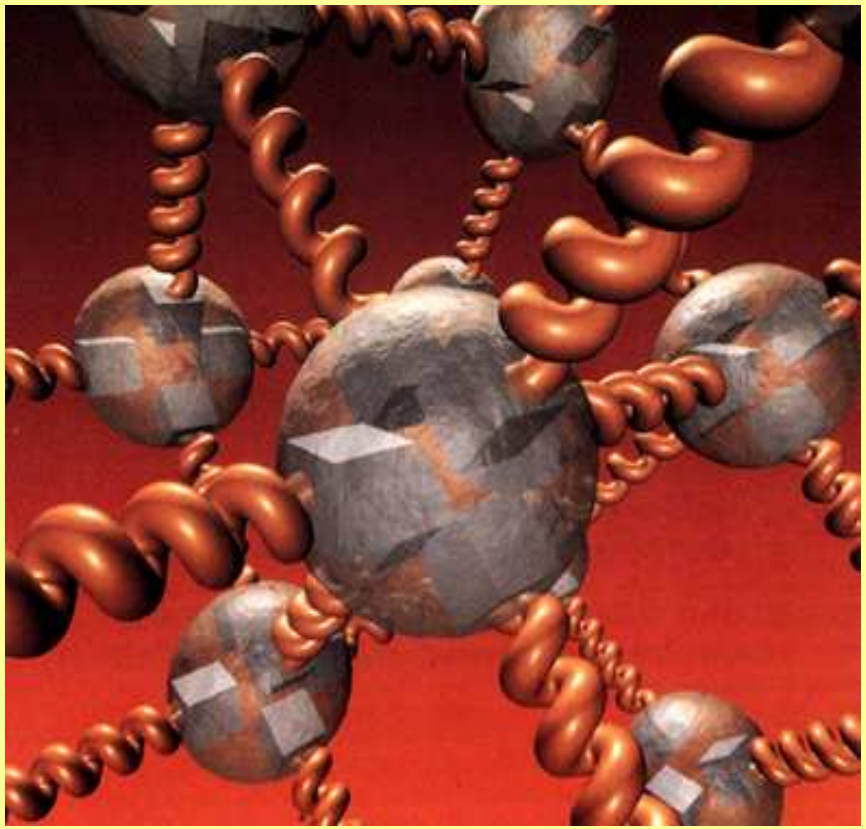
- **Spread between gas and liquid feeds now down to $.05**
- **Demand is shrinking – tire demand is down**
  - Asian market price drop of $0.10- $0.15 per lb

October 2008



- **Hurricane Ike – temporarily shut down Gulf Coast crackers**
  - Expected Bd price increase of $0.10 per lb
  - Reduced demand caused spike of only $0.04 per lb
- **Crackers are back on line, but tire compound plants are not**
  - Result – 100% Bd available to SBS producers for now
  - SBS suppliers may be able to build up substantial inventory this winter

Alternatives to SBS Polymer



- SBS polymer-modified asphalts are typically cross-linked systems
  - Contractor friendly
    - Terminal blend supply
    - Do not require agitation
    - Storage stable
    - No major changes to HMA plant operation
    - No major changes to HMA laydown and compaction
- Alternative modification systems need to exhibit similar qualities

Alternatives to SBS Polymer

- **SBR Latex – butadiene based polymer that is not in short supply at this time**
  - **Not storage stable**
  - **Must be blended at HMA plant**
- **Non- butadiene polymers**
  - **Reacted Ethylene Terpolymer (Elvaloy)**
  - **Ethyl Vinyl Acetate (EVA)**
    - **Used in warm climates**
    - **Blended with SBS in cold climates**
- Polyphosphoric Acid (PPA)
  - **An extender, not an alternative**
  - **Can be blended with SBS to reduce SBS content**

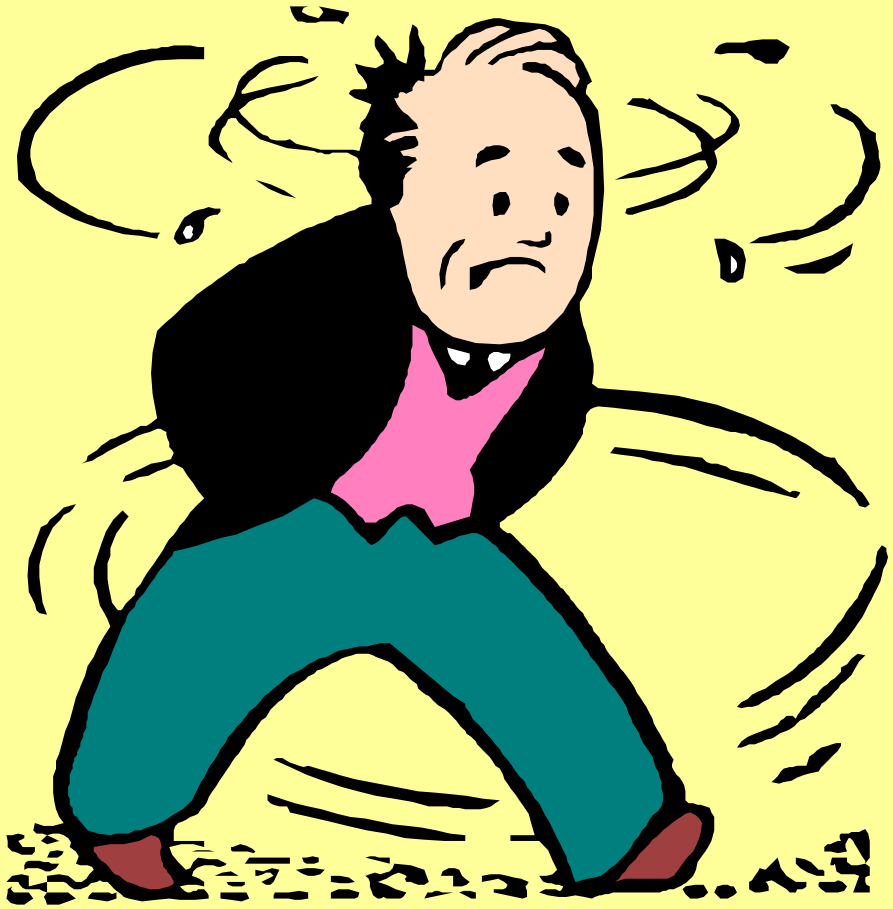
Alternatives to SBS Polymer

- **Ground Tire Rubber (GTR) – wet process**
  - **15-20% GTR melted and swelled into asphalt**
  - **No cross-linking occurs**
  - **Not storage stable**
  - **Not a terminal blend process**
  - **AR binder cannot be PG graded in a meaningful way**

Alternatives to SBS Polymer

- **Hybrid Binders**
  - **Blend of SBS and GTR**
  - **Cross-linked system**
  - **Storage stable**
  - **Terminal blend system**
  - **Current research sponsored by FL DOT at University of Florida**

Alternatives to SBS Polymer



- **‘NOTHING’ is not an option**
  - **PG Grading system is based on climate and traffic**
  - **Using the wrong grade will lead to poor performance**
  - **We have enough historical data to prove that PMA does improve pavement performance**
  - **Flexibility and creativity are needed to come up with answers**

DON'T SHOOT THE MESSENGER

Questions?