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Energy and commodity price benchmarking and market insights

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illuminating the markets

Aromatics Markets

Houston, TX

Chuck Venezia

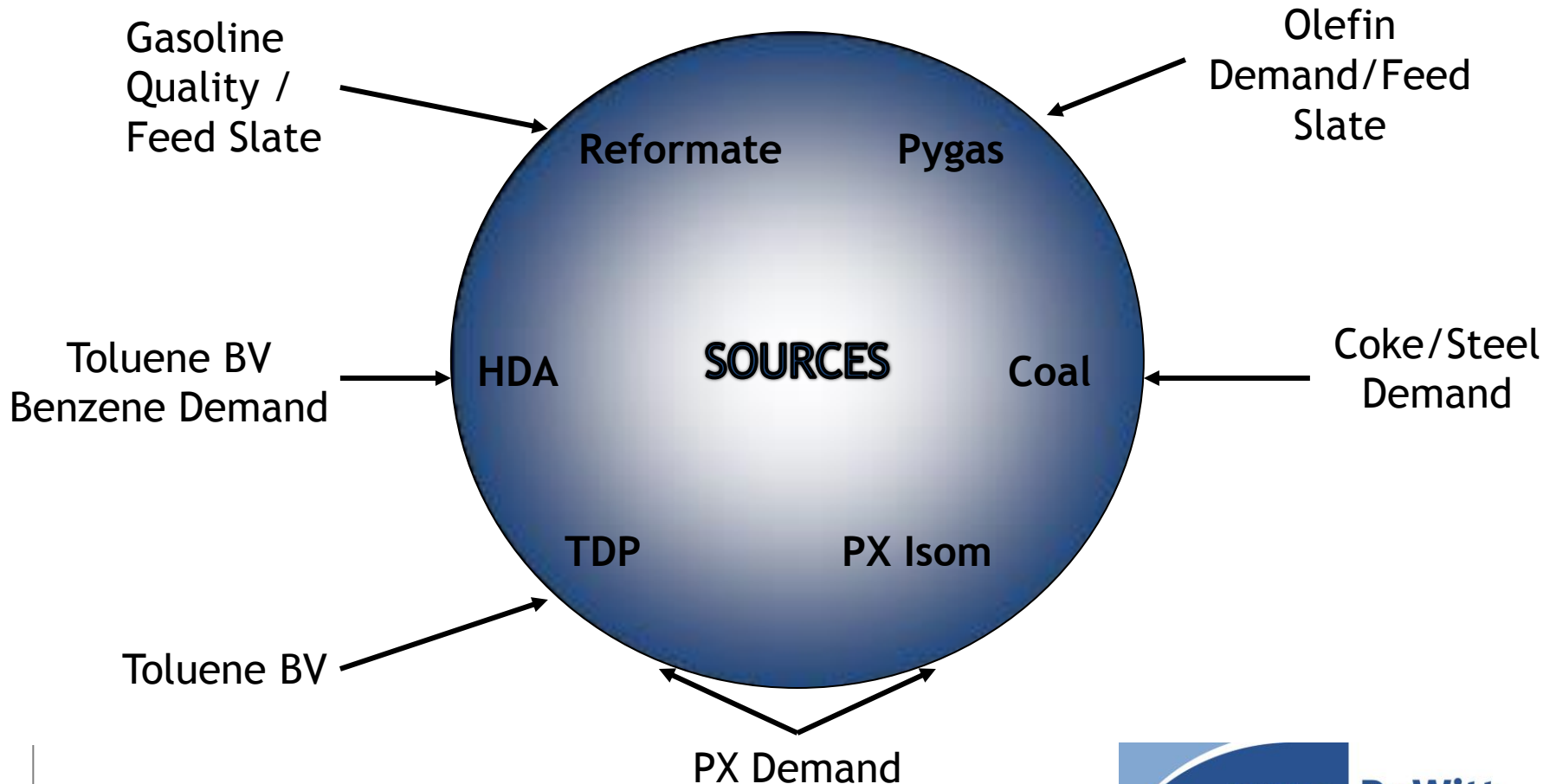
Vice President, Petrochemicals
ArgusDeWitt

September 23, 2014

Agenda for the Session-Benzene

- Benzene market trends
 - How is benzene different from other commodities?
 - How is price settled? How is it differentiated?
 - Who are key players?
- Supply sources and economic factors that have limited benzene production
- Global Benzene trade flows, with a closer look at the USA situation
- What is the outlook for the benzene market?

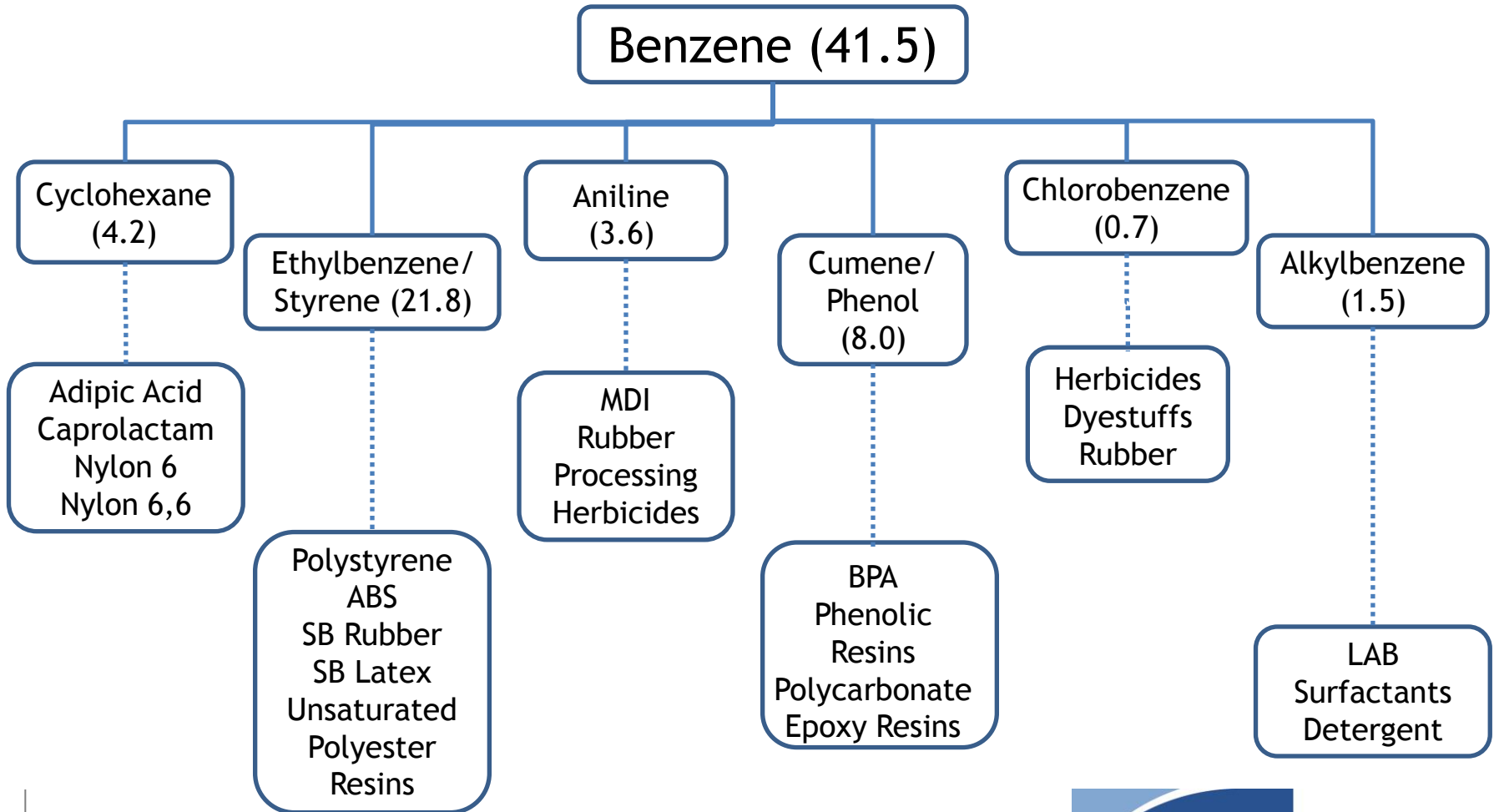
Numerous Impacts on Benzene Supply/Price



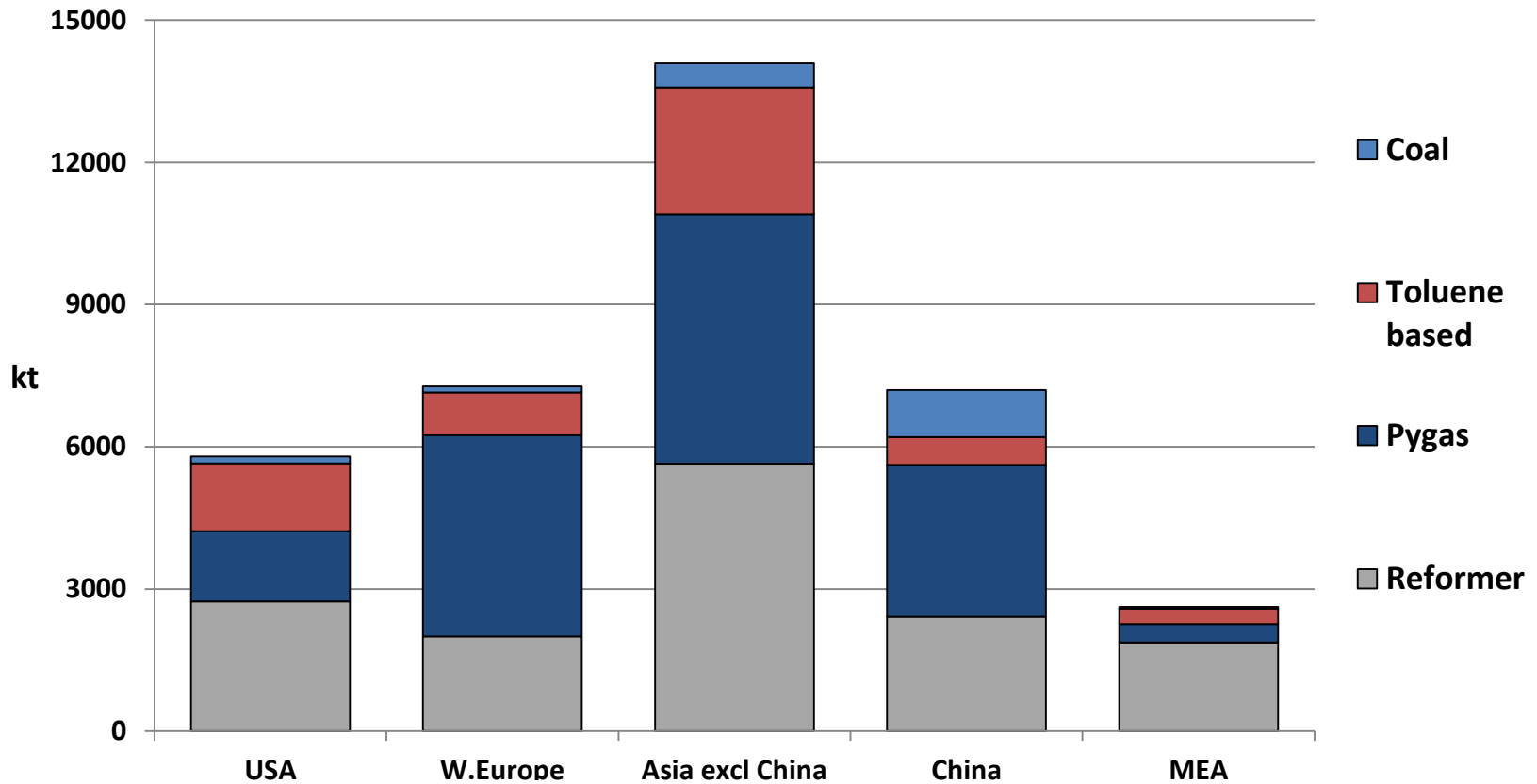
Recent shifts have limited benzene production

- Reformate extraction limited by:
 - declining petroleum-based gasoline demand
 - MSAT 2 regulations
 - More usage of “renewable” or “green” blend components
 - Shift in crude quality
 - More emphasis on middle distillate production
- Pygas extraction limited by:
 - Advantaged “light” feeds produce much less pygas
 - Fewer imports of pygas

2013 Argus DeWitt Global Benzene & Derivatives



Regional Benzene Production Sources 2013

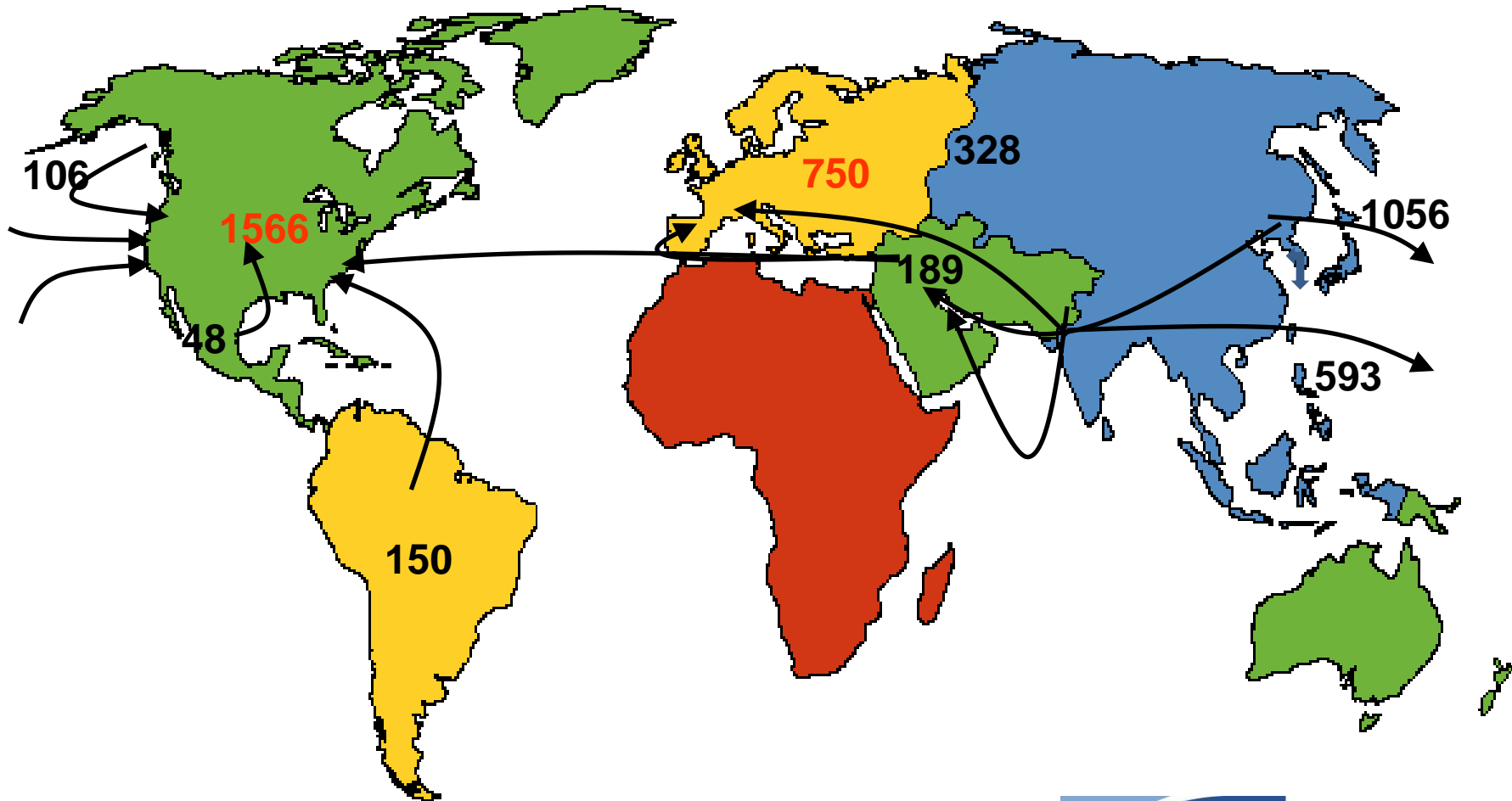


Top 10 Benzene Producing and Consuming Countries

Top 10 Benzene Producing Countries		
	<u>2013</u>	<u>2017</u>
China	7625	10317
United States	5667	5713
S Korea	4356	4841
Japan	4183	3939
Netherlands	1931	1960
Germany	1811	1706
Saudi Arabia	1580	2213
Taiwan	1431	1559
Thailand	1230	1215
India	1200	1650

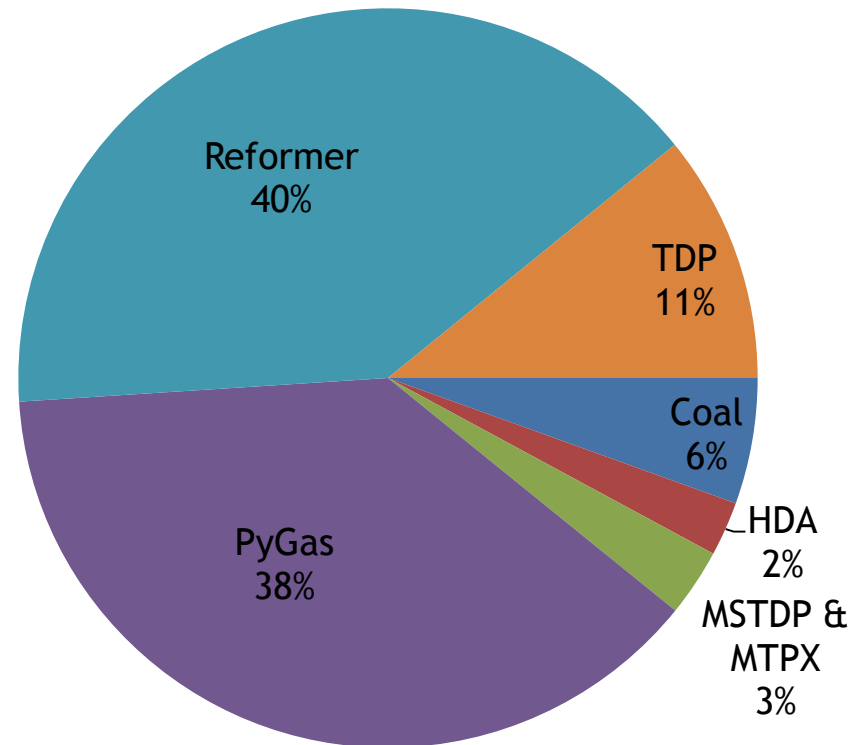
Top 10 Benzene Consuming Countries		
	2013	2017
China	8481	11380
United States	7181	7405
Japan	3558	3476
S Korea	3176	3823
Taiwan	2000	2121
Netherlands	1970	1832
Saudi Arabia	1943	2385
Germany	1699	1701
Singapore	1215	1245
Russia	1083	1141

2014 World Benzene Trade



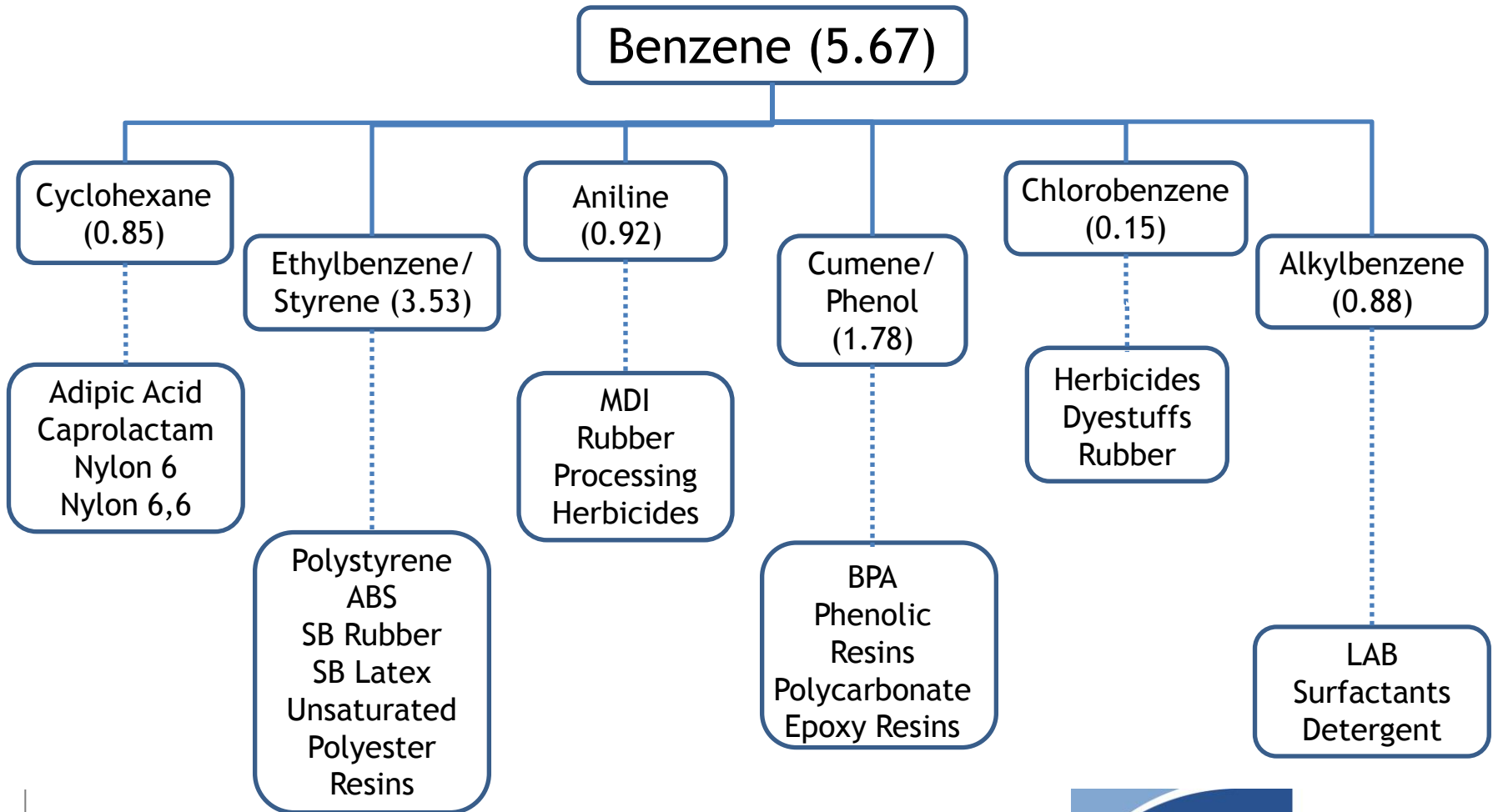
2013 China Benzene Production by Source

- 21875 KT Total Production
 - World Production 41483 KT
 - 52.7% of Production
- 2013 Weak year for Coal sourced benzene
- China imported nearly 1 million tons benzene in 2013



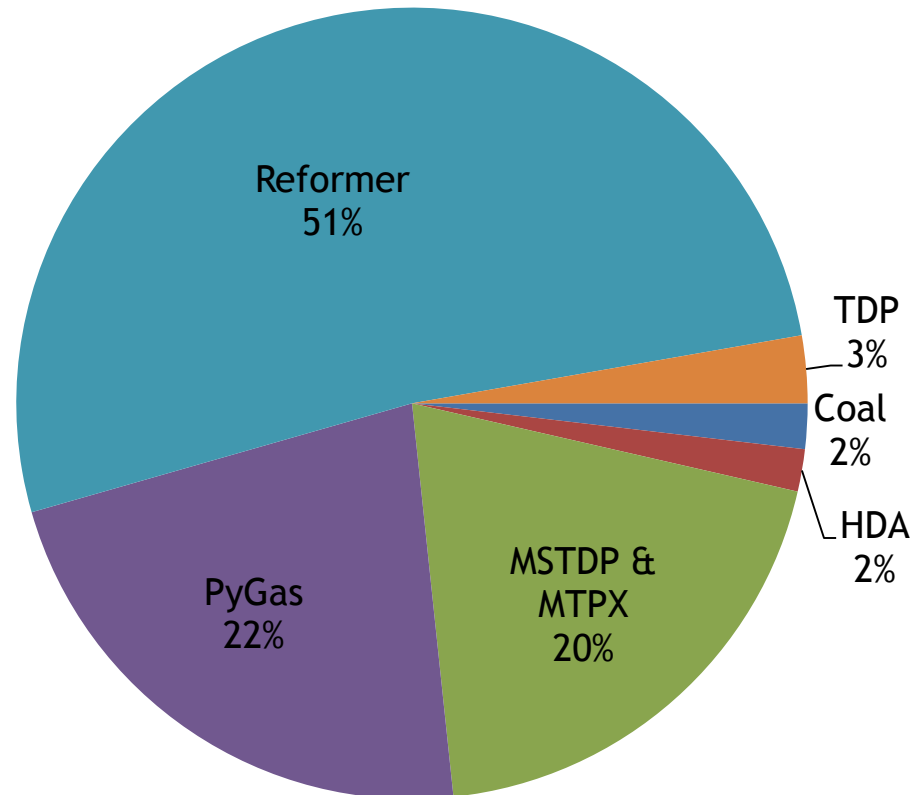
Benzene in the USA

2013 Argus DeWitt US Benzene & Derivatives



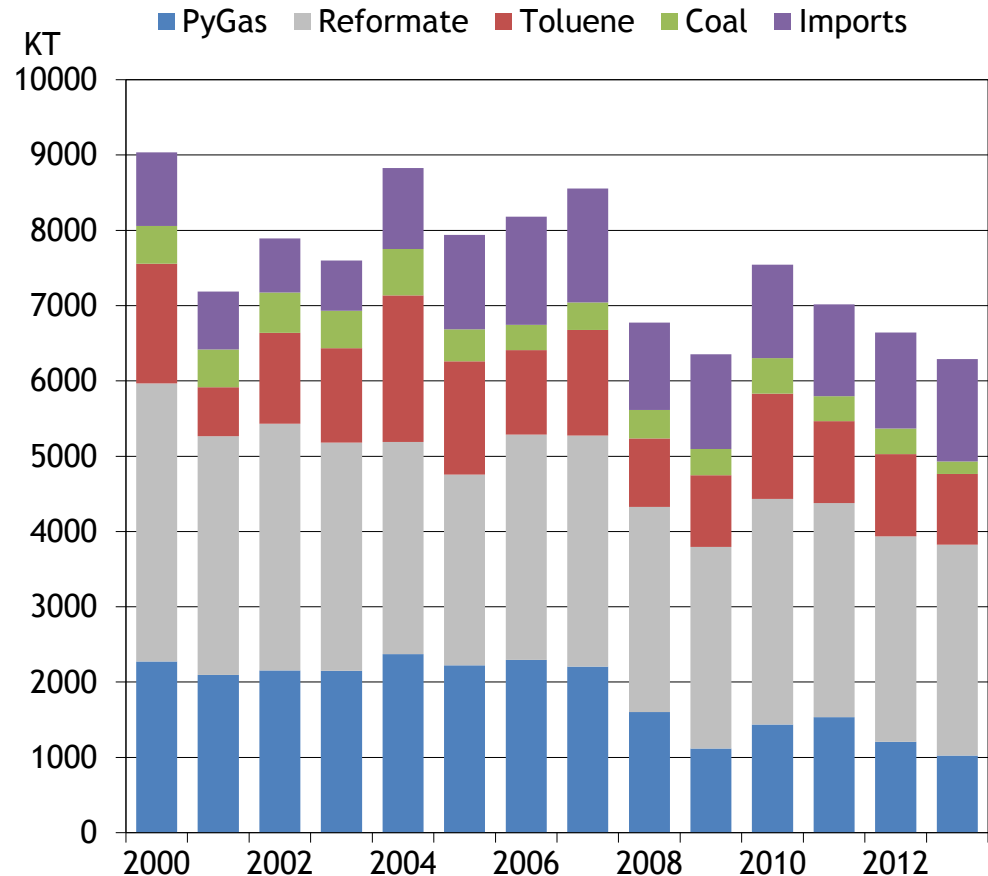
2013 United States Benzene Production by Source

- 5667 KT Total Production
 - World Production 41483 KT
 - 13.7% of Production
- Reformate Extraction is Majority
- Pygas extraction declined by 1 million tons since 2006



2000-2013 Total US Benzene Production with Imports

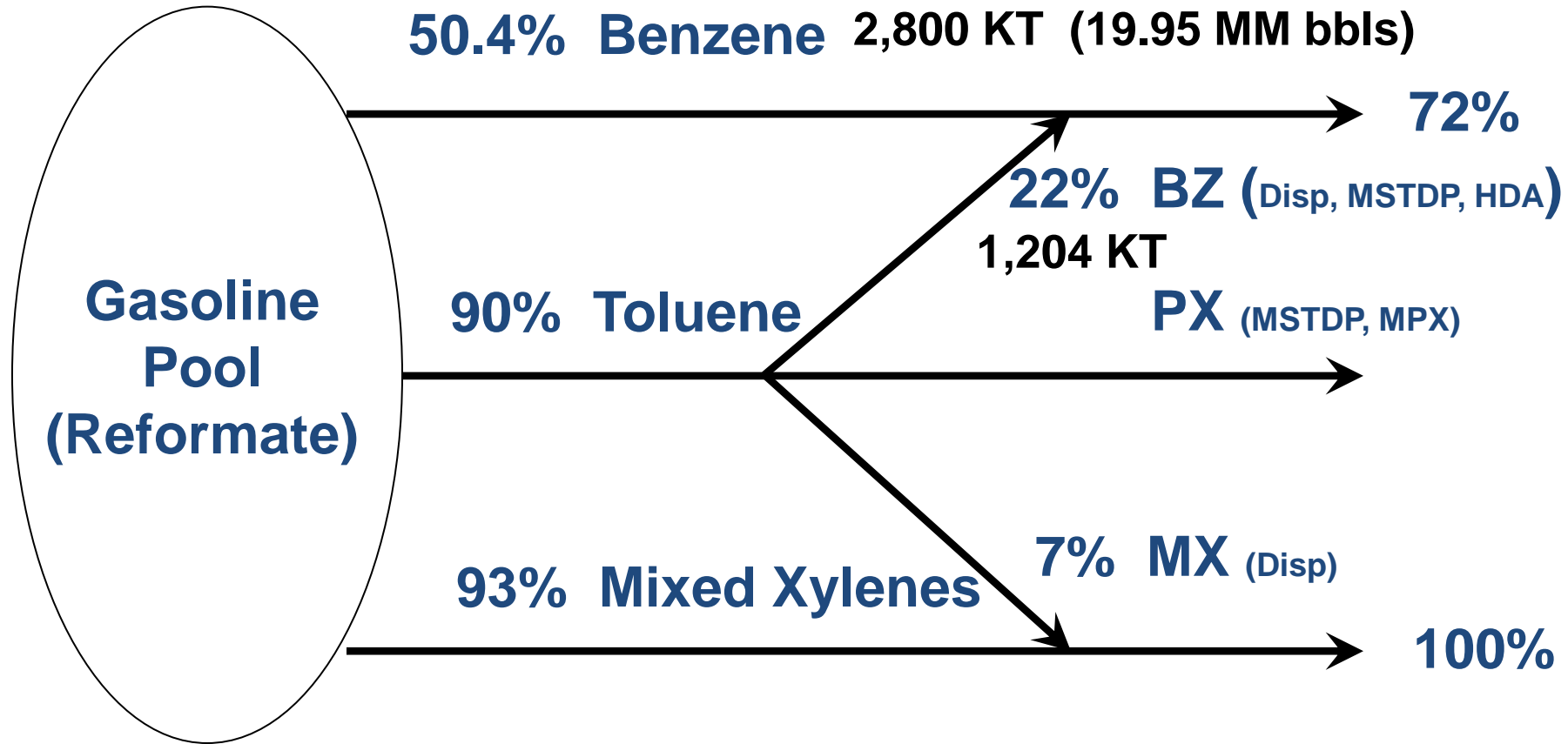
- Demand was 9 million tons in 2000
- Decreased by nearly 1/3 by 2013.
 - Imports account for more than 20% of demand
 - Less extraction feed offset by decreased demand from derivative units



Reformer Operations

- Yields impacted by:
 - Quality of naphtha
 - Severity
 - Operating rate
- Three contributions to gross margin
 - Octane, or blend, value
 - Hydrogen and LPG, credit tied to natural gas, or fuel oil, price
 - Aromatics, chemical value

2013 US aromatics production from reformat



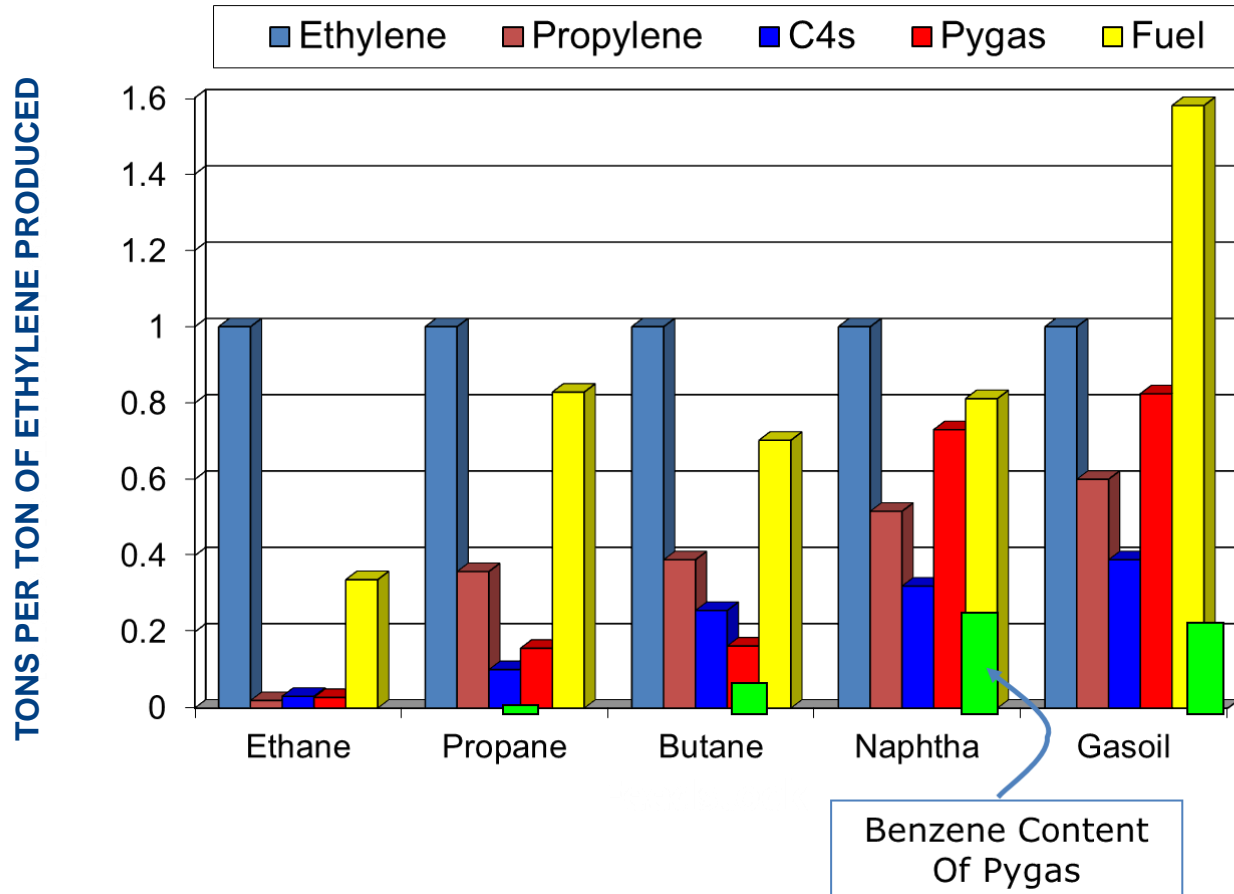
Crude oil quality comparison

Crude Comparison Table						
		NSD	Bonny Lt	WTI	Eagle Ford	Bakken
API Gravity		37.9	35	40	45	42
Sulfur	Wt%	0.45	0.15	0.33	0.4	0.2

Yields	Vol%					
Light Ends		4.1	1.7	1.5	3.8	3.5
C5-165 C Naptha		25.3	22.2	29.8	40.1	35.7
Jet 165-235 C		12.4	15.8	14.9	12.6	13
Diesel 235-360 C		25.6	37.4	23.5	17.1	17.8
VGO-360-540 C		23	18.3	22.8	21.2	24.8
Resid 540+ C		9.6	4.6	7.5	5.2	5.2
Total		100	100	100	100	100

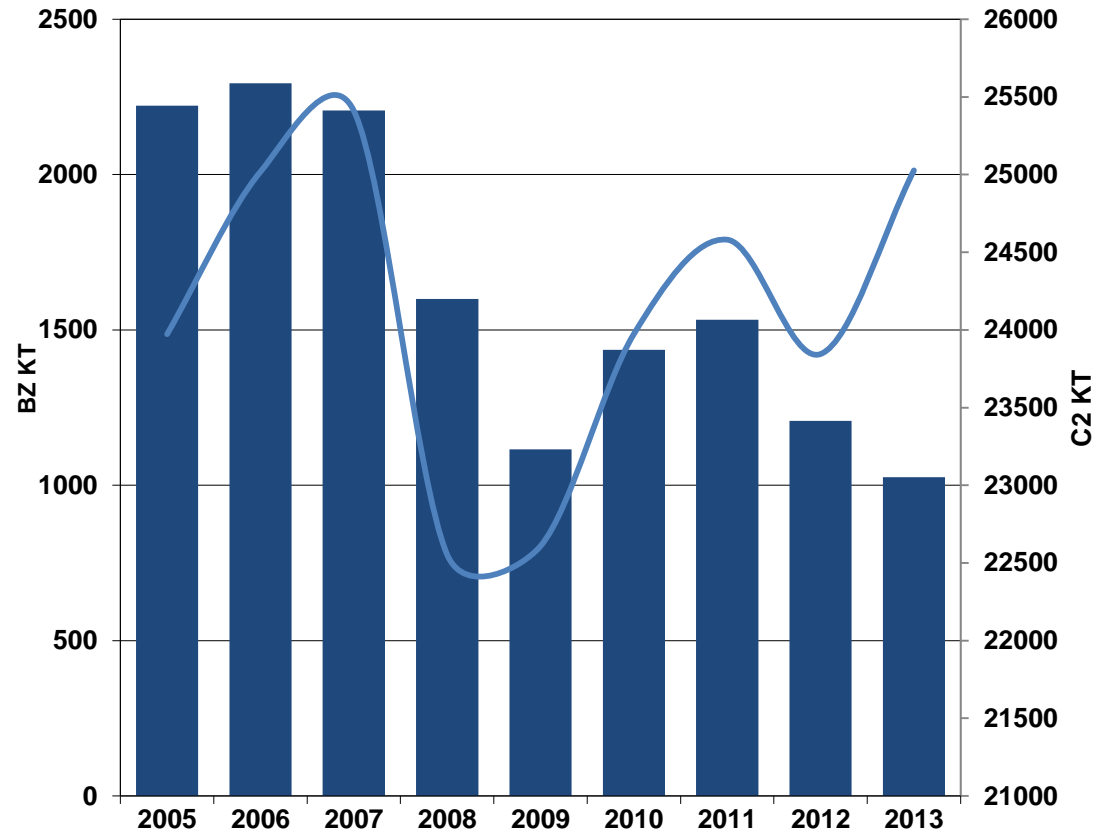
C5-165 C Naptha	Vol%					
Napthenes		39	51	38	21	23
Aromatics		15	12	12	11	13
N+A		54	62	50	32	36

Where the choice of feedstock has a significant impact on the volume of products produced and their economics



2005-2013 total NPRA US benzene production from pygas compared to total ethylene production

- Ethylene produced from full range naphtha yields 12 times pygas and 8 times benzene volume per ton of ethylene yield
- C2 production in 2005 was 0.6% greater than 2012
- Benzene from pygas was 45% lower in 2012 (1 million tons) primarily due to shift in feedstocks



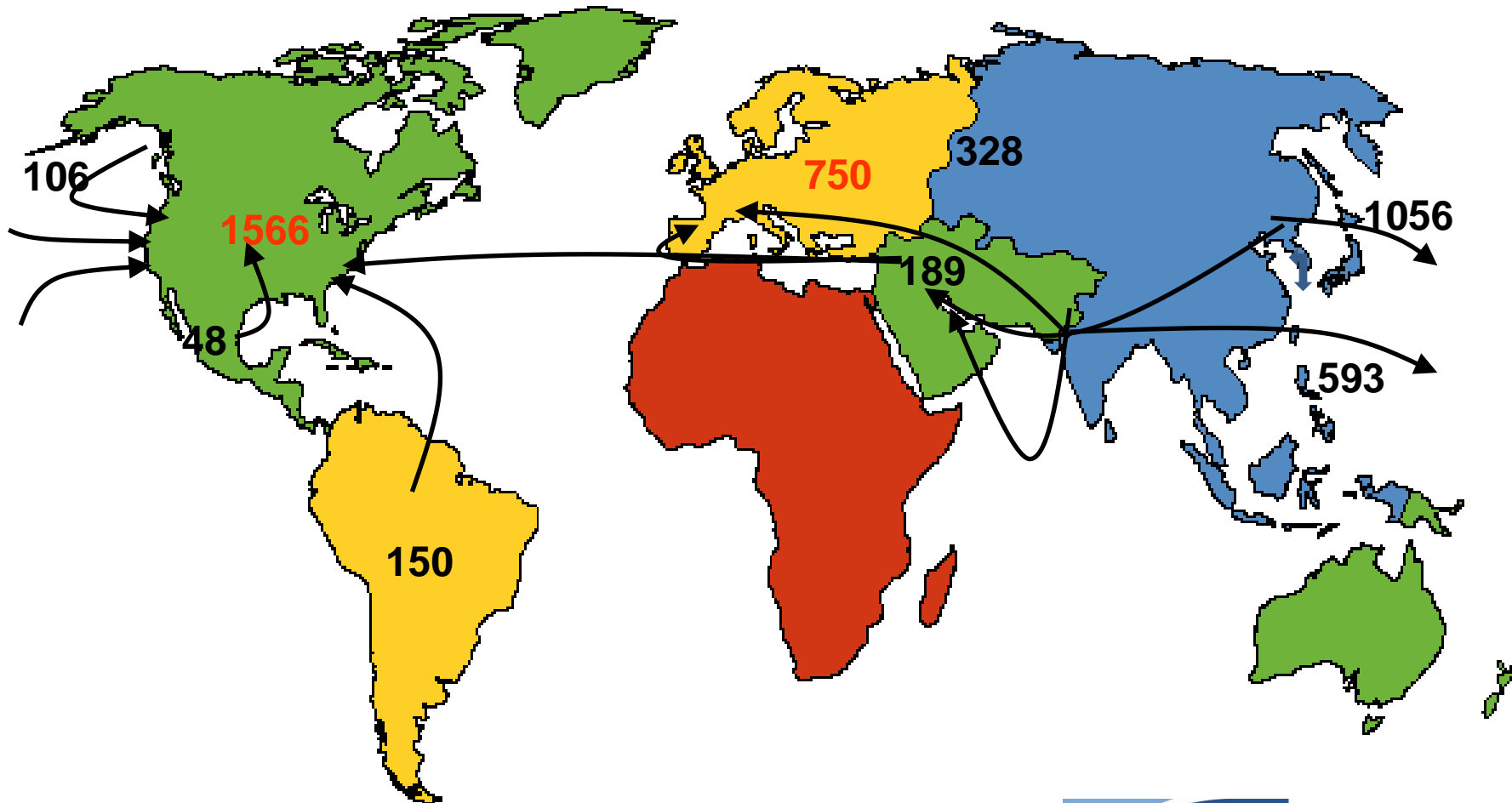
Source: NPRA/DeWitt

Pygas Extraction

- Impacted by type of feed into steam cracker and severity
- Pygas valued:
 - on a weight (\$/mt) basis in Asia and Europe, with benzene % at monthly benzene price and remainder of the stream at regional naphtha price.
 - On a *volume* (\$/gal) in USA, with benzene % at monthly benzene price and remainder of the stream at regional *gasoline* price.

Benzene Price Movements and Influencers

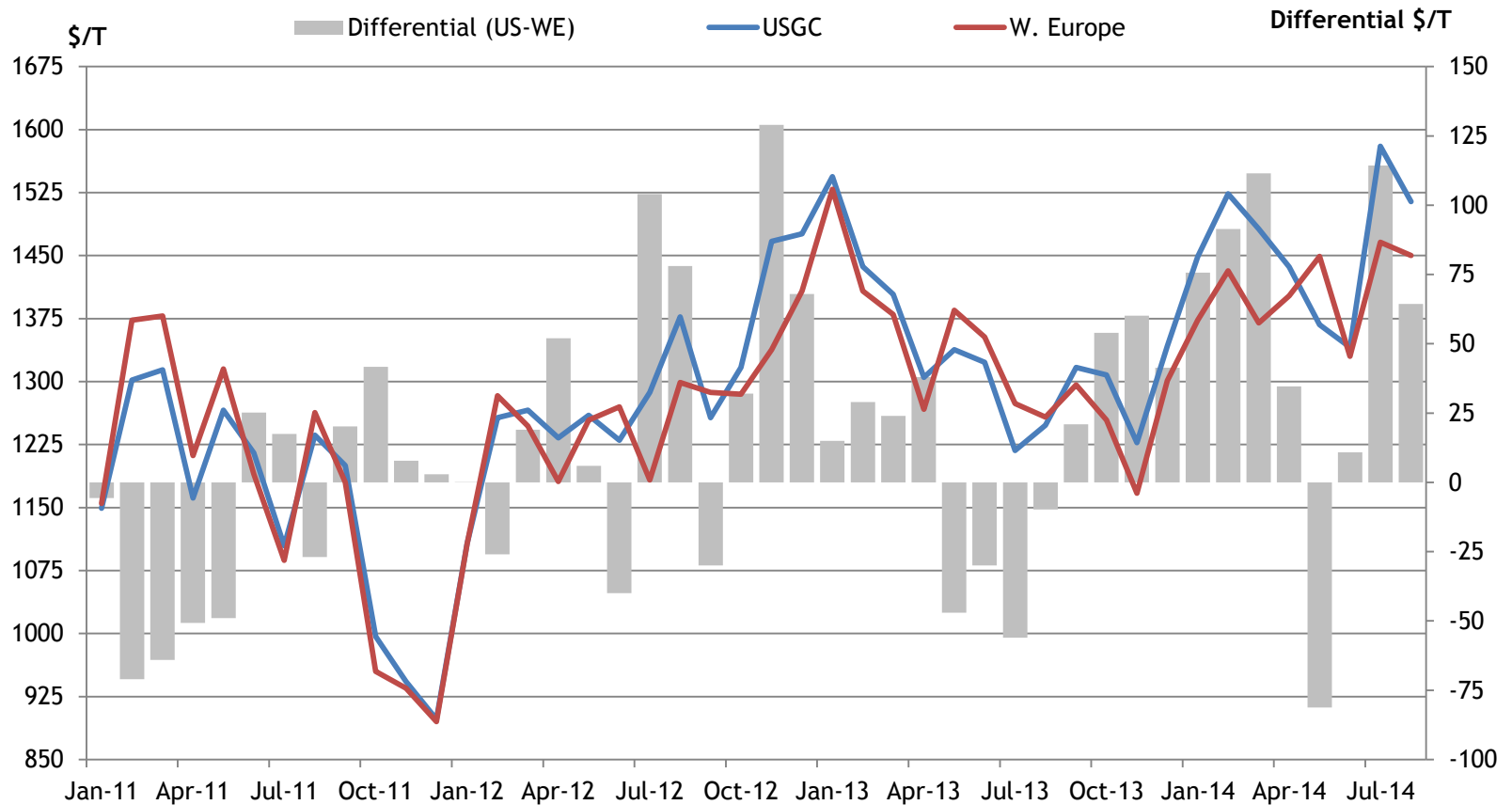
2014 World Benzene Trade



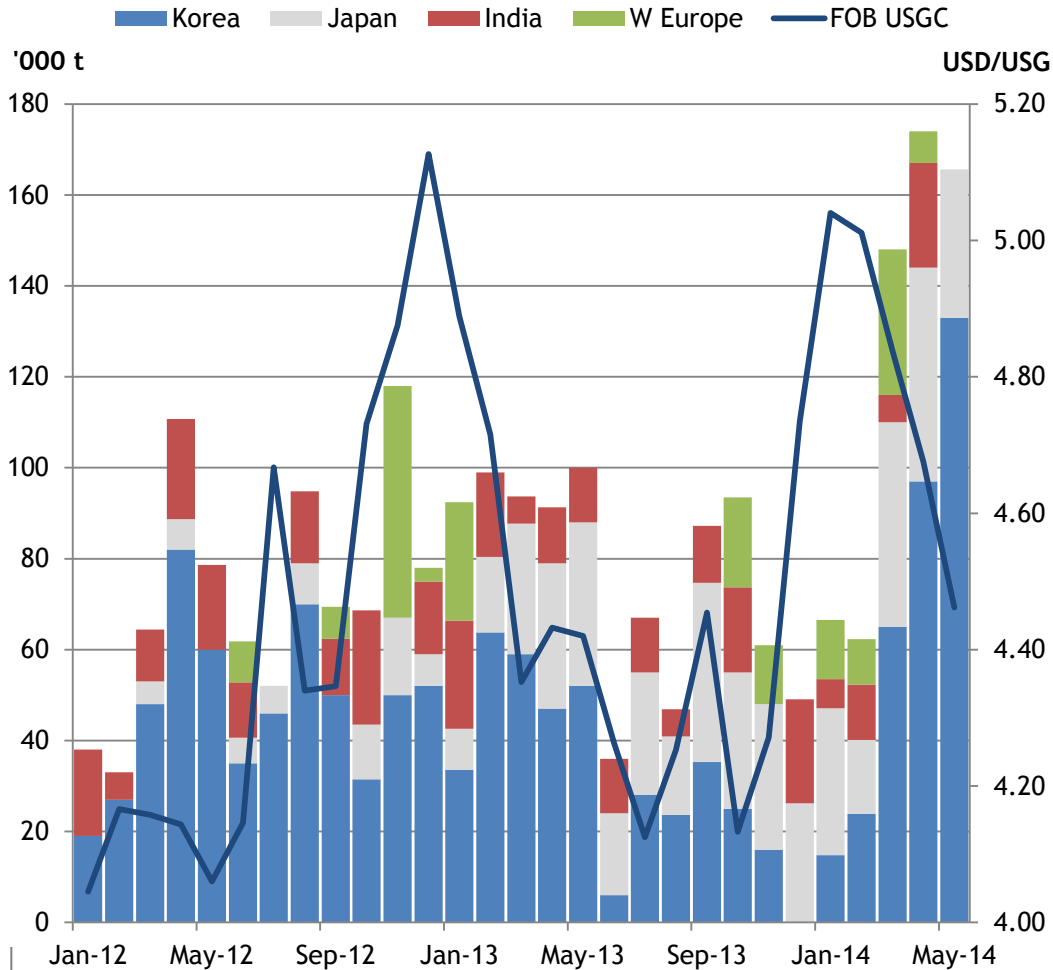
Recent Benzene Price Trends

- USA and Europe take turns as global price leader; other regions are price takers, usually by a factor of freight cost.
- Import volume, or incremental production from toluene, set the regional price.
- Monthly contract price in USA negotiated by ExxonMobil and Phillips 66 from supply side and BASF, Sabcic, Total, Huntsman, Styrolution, Ineos Phenol, et.al from the Buy Side.

2011-2014 Benzene Contract Comparison



2012 - 2014 Monthly US Benzene Imports with Spot Price

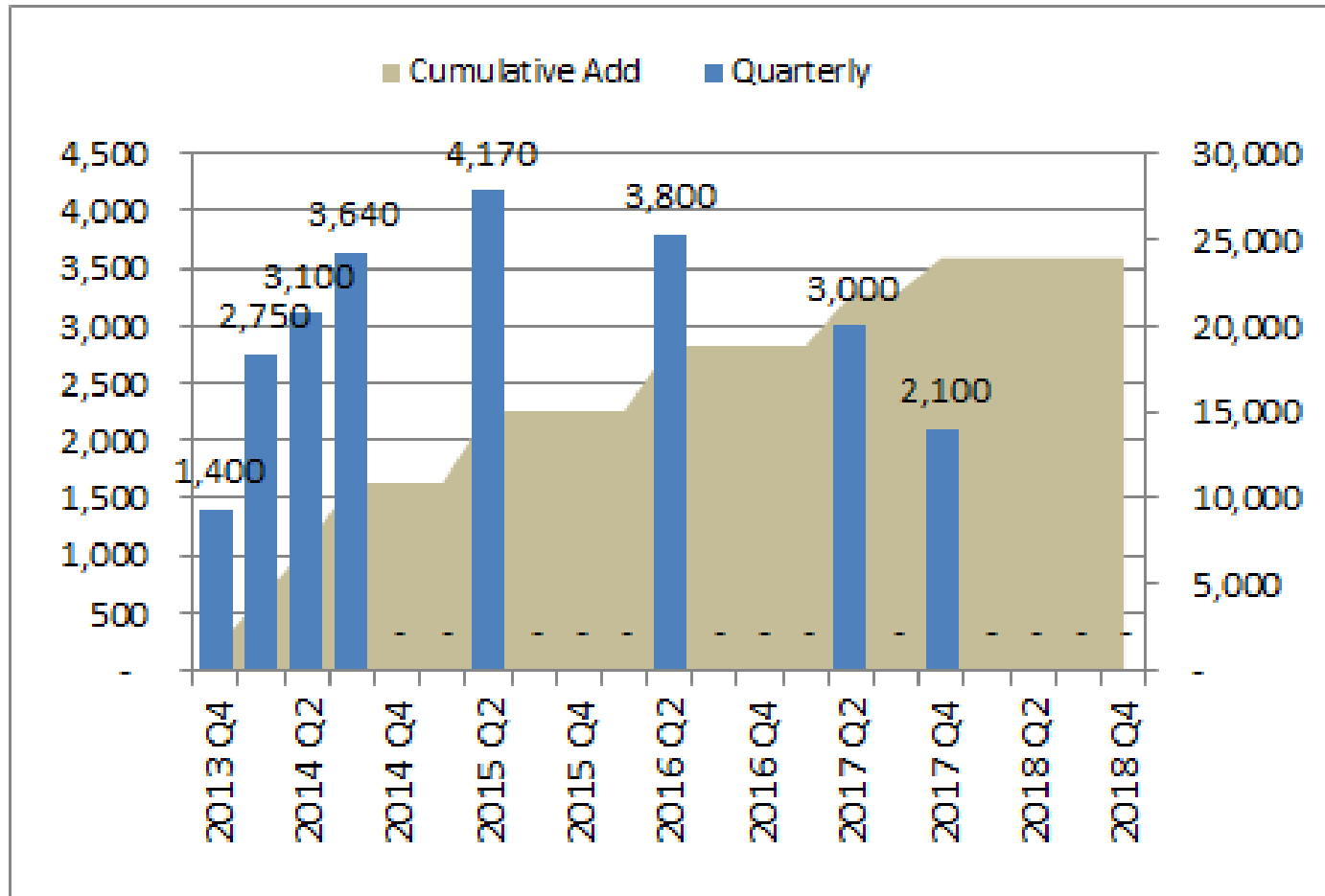


Benzene Imports by Country of Origin (in '000 t)				
	2013	2012	Change	Change in %
Korea	389.4	570.5	-181.1	-31.7%
Japan	312.1	68.3	243.8	357.0%
Brazil	160.3	139.5	20.8	14.9%
India	156.8	158.6	-1.8	-1.1%
Canada	148.9	165	-16.1	-9.8%
Saudi Arabia	97.2	93	4.2	4.5%
Other	92.1	81.5	10.6	13.0%
Total	1356.8	1276.4	80.4	6.3%

Key Issues/Conclusions

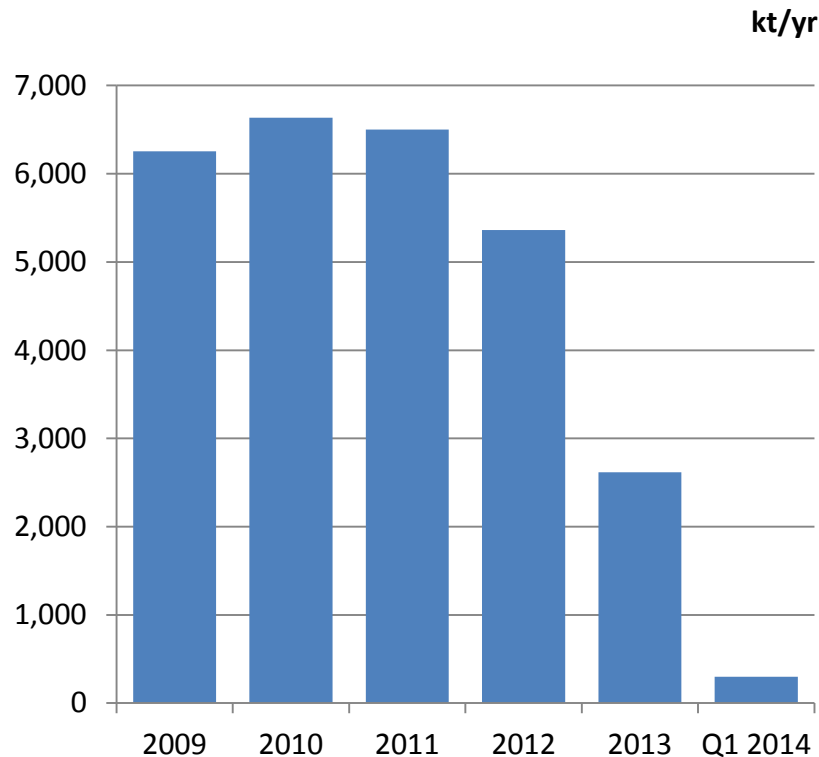
- US Imports of Benzene, and Exports of Styrene expected to Increase
- Future of China Benzene Trade Balance?
- How much byproduct benzene will come out of new PX capacity?
- Will there be additional on-purpose capacity added?

Expected Global Paraxylene Capacity Additions

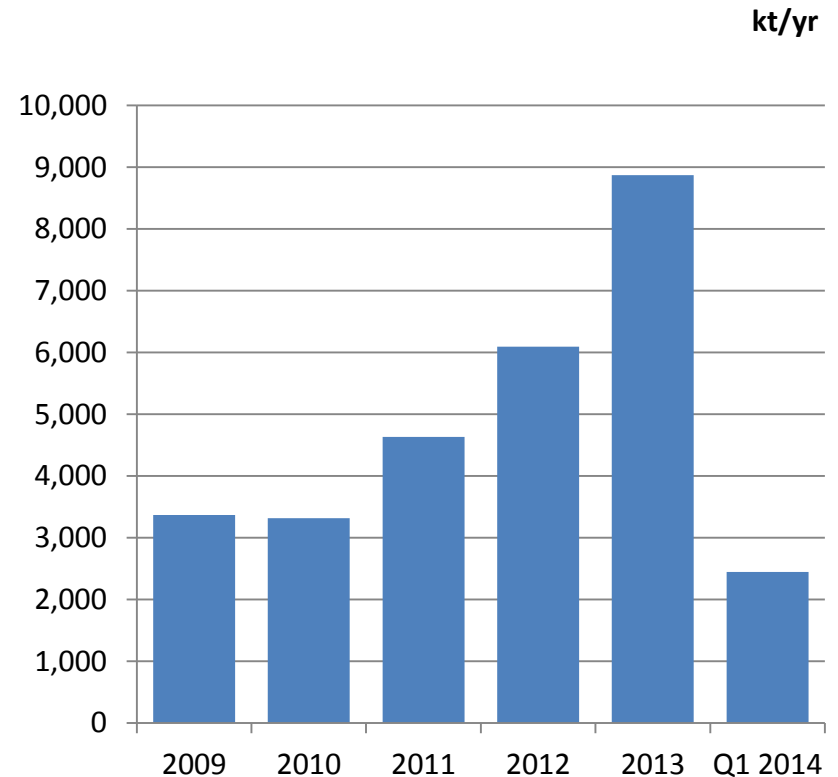


China Terephthalic Acid & Paraxylene net Trade

Terephthalic Acid net Imports

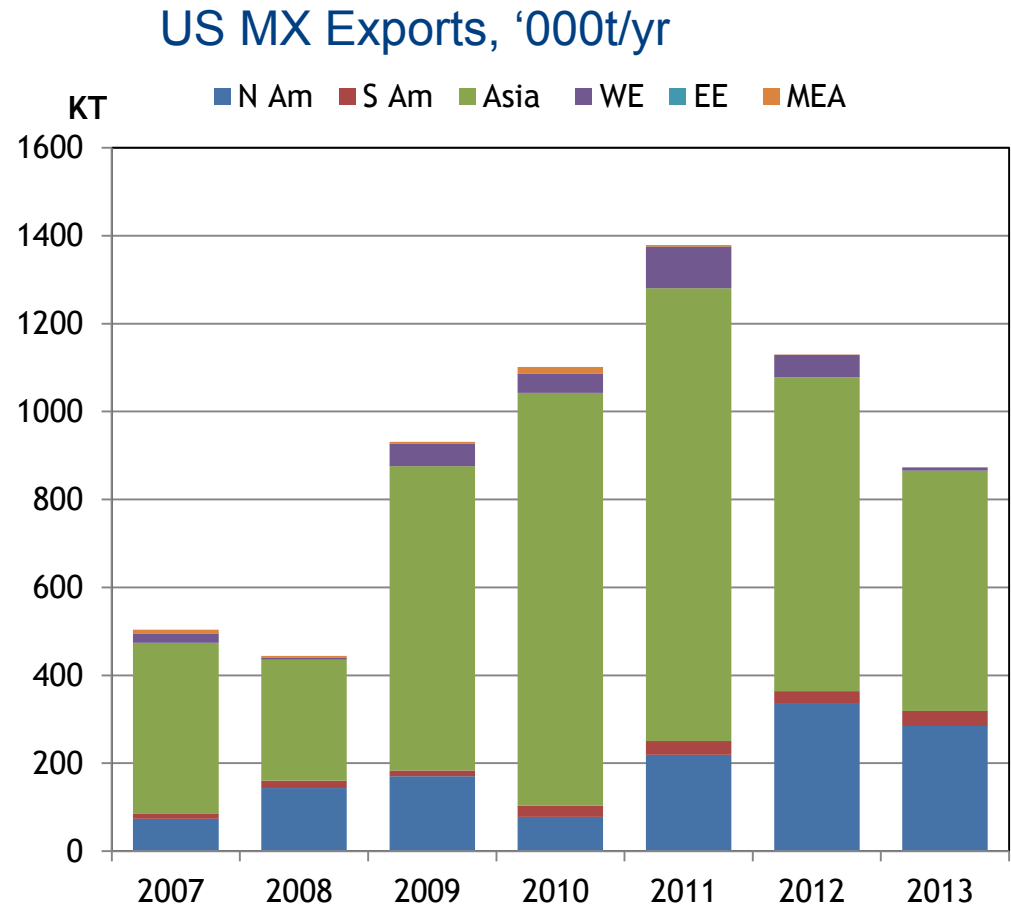


Paraxylene net Imports



Xylene Exports from US; Asia Demand

- Ramping up since 2008
 - 2012 Hovensa S/D
- US producers working on ways to increase production
- More investment coming?
- Globally, only about 30-35% of mixed xylenes produced are recovered for petchems
- By 2020, this needs to rise to closer to 60% to meet demand
- Data from US Customs



PX, MX, and Toluene Outlook

- PX from Naphtha will be challenged with PX to N averaging \$300/ton based on prior historical low levels (2009 – 2010), due to overcapacity and softness in downstream polyester chain.
- MX prices will lag blend values in the US during the summer by 30 to 40 c/USG and may see more severe lag due to PX
- MX to PX production economics will be challenged with margins averaging \$150 /ton for 2014. (see prior historical lows 2009-2010)
- Toluene prices may be 30 c/USG below summer blend value and may see pressure from toluene imports until 4Q

Final Thoughts

- Don't be carried away by short term developments:
- Strong Paraxylene Growth will over time tighten Mixed Xylenes Markets
- Increased Extraction of MX for PX (>60% of global MX production after 2020) will increase the Value of Toluene for Gasoline
- High Toluene Values will support both Benzene and Xylenes Prices through Disproportionation Economics
- Pricing for Mixed Xylenes will move above Benzene; the margin between MX & PX will stay squeezed
- Tightening Feedstock Availability, particularly Heavy Naphtha, will restrict new Construction
- Aromatics Extraction will be profitable for those with Access to Competitive Feedstock