State of the Global Petrochemical Industry

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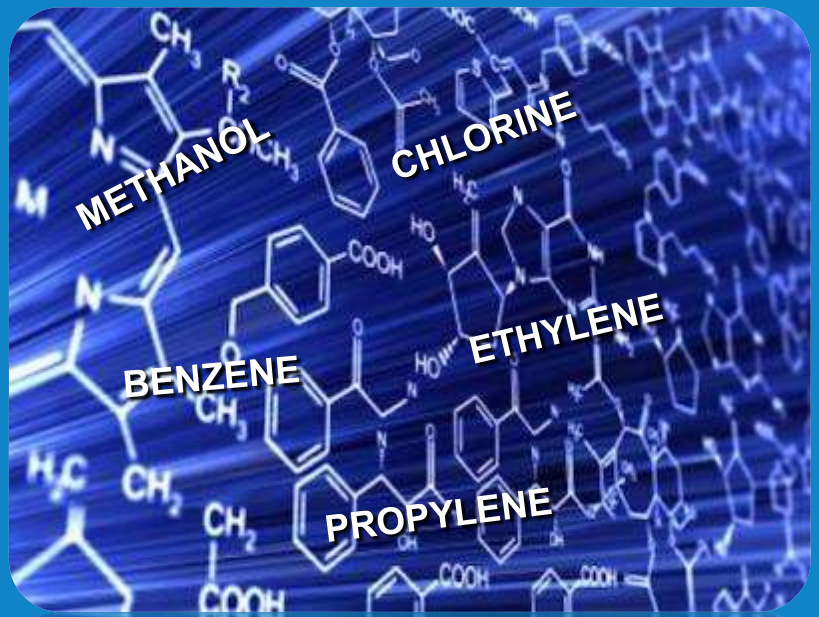
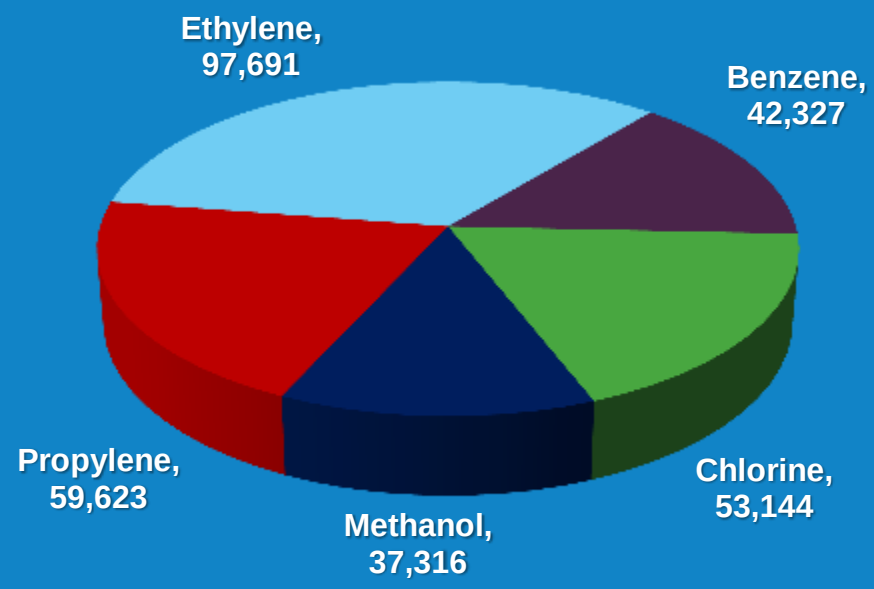
Agenda: State of the Industry



- Key Drivers In Base Chemicals
- Impact of Energy at the Extremes
- Regional Strategies
- Evolving Trade Dynamics
- Final Thoughts

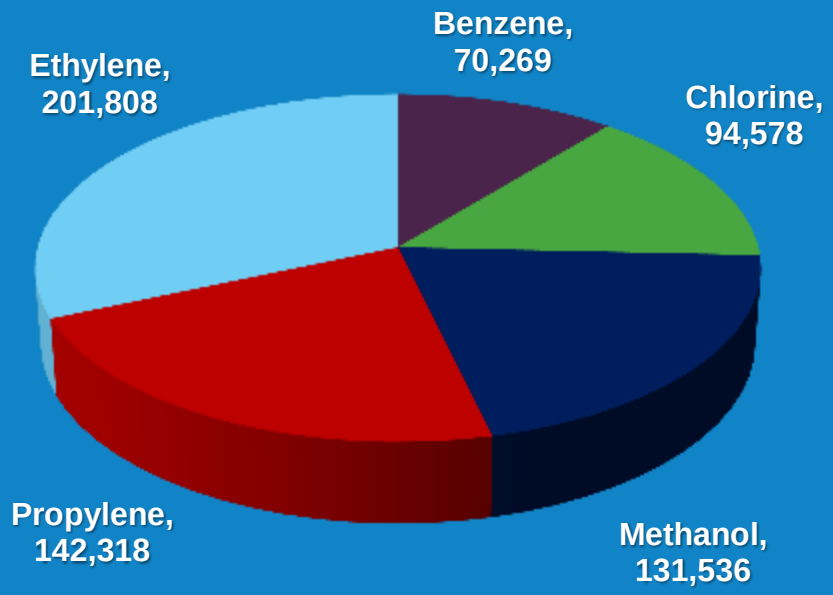
Basic Chemicals Global Capacity

2000



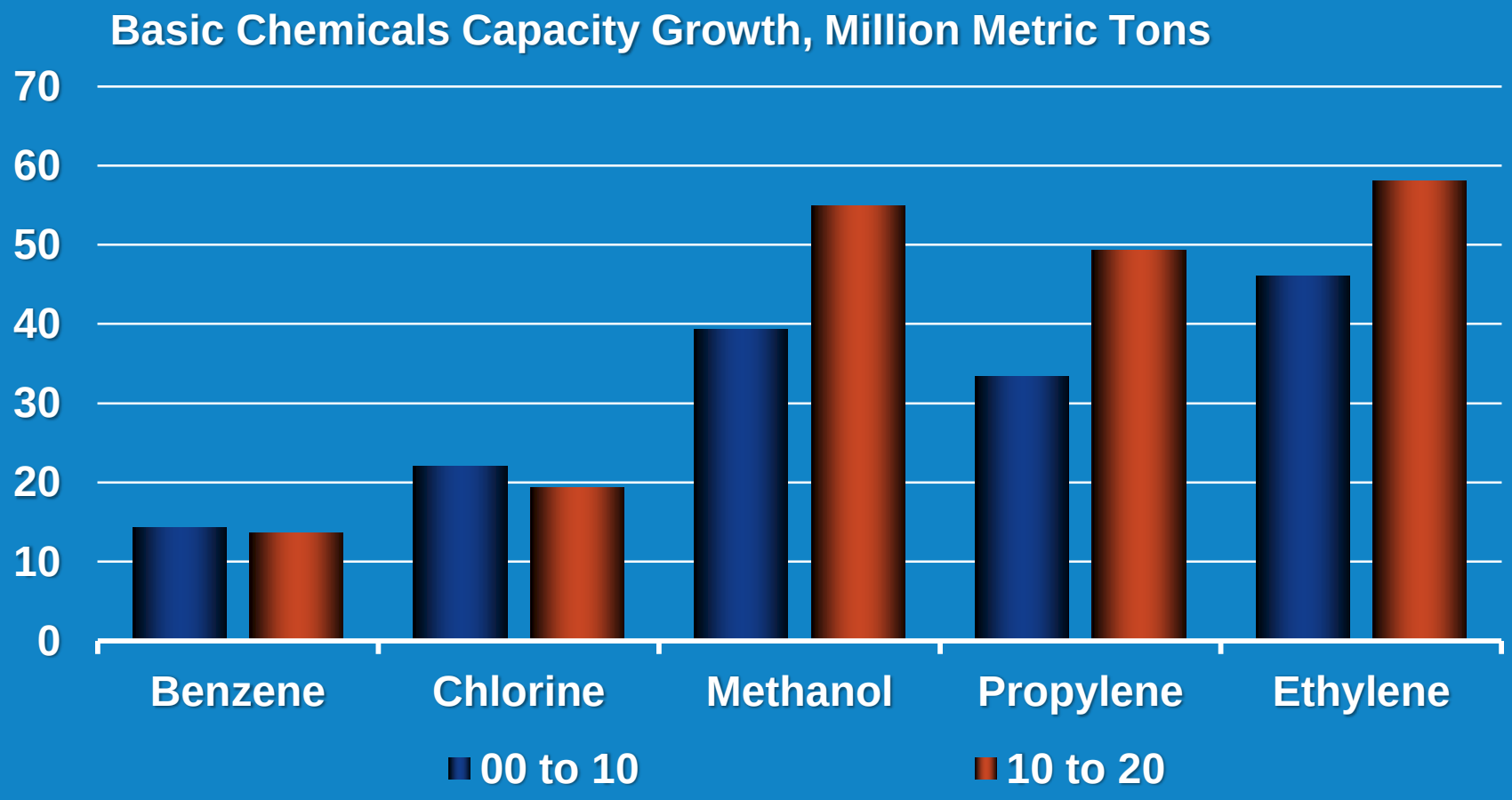
290 Million Metric Tons

2020



640 Million Metric Tons

Changes In Energy & Demand Growth Incentives Show Varied Results



Chemical Investments Seek A Sustainable Advantage

Energy & Feedstocks

…make up 60-70% of the costs of chemical production. Investments seek a competitive advantage in energy and feedstock costs.

Demand Growth

Proximity to demand growth essential without distinct cost or technology advantage. Trade access is also key.

Technology

Technology to enable competitive production costs, economies of scale, high performance products. First to market is important.

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Strategic Issues In Base Chemicals

- Incentives to build on-purpose threaten oversupply near term; US market shift in value to chemicals versus refining; demand trending towards GDP

- Crude oil to natural gas ratio is key to location of new capacity; and keep one eye on coal in China; new technology developments underway

- Understanding China is key; light olefins feedstock and fuels end-uses stimulate demand growth

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Strategic Issues In Base Chemicals

- Electricity cost is the major factor; demand growth linked to construction materials; integration from ethylene to PVC provides competitive edge in US.

- Supply trends complicated by refining and chemicals; benzene trades while derivatives are local; Asia supply to North America is key.

The Demand Pull On Chemicals Starts With Consumers

Consumers

Retail

Consumer Goods

Energy

Petrochemicals

Derivatives

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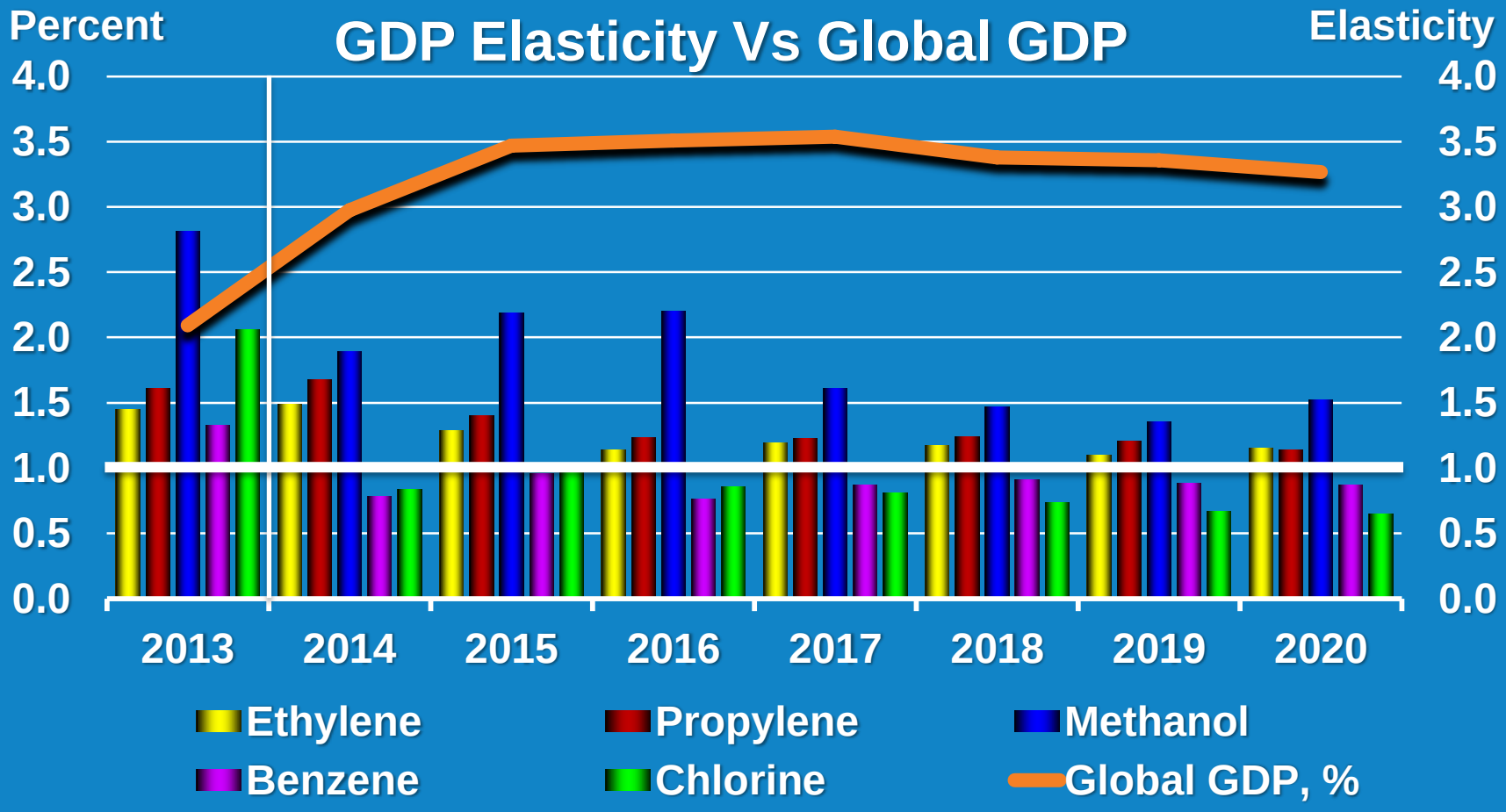
Steady Global GDP Growth Is Essential To Energy Demand

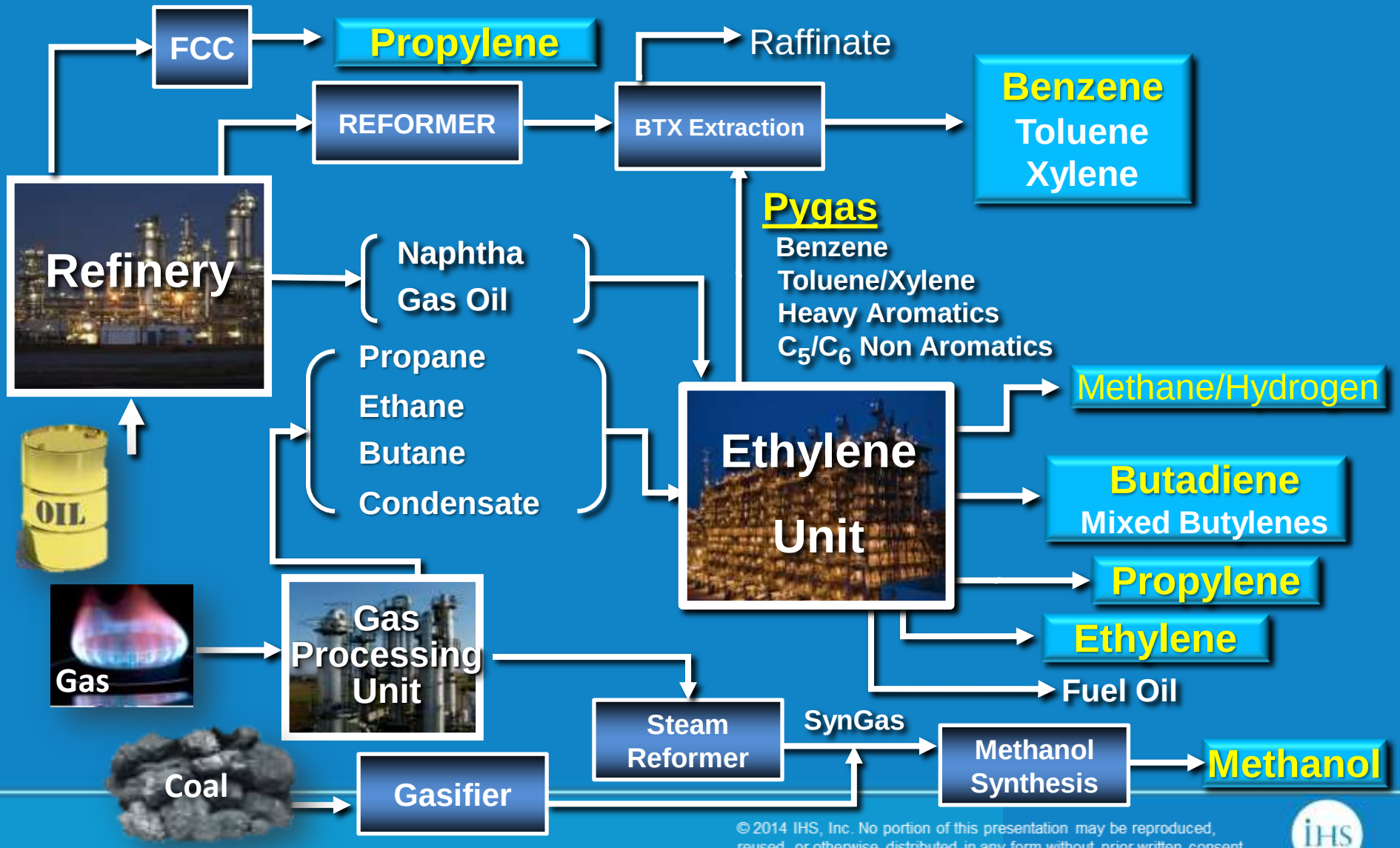


Energy at the Extremes

Opportunities & Risks

- **Crude oil** priced near $100/bbl, and NAM natural gas prices near $5/MMBtu, likely sustained based on energy supply/demand outlook.
- **North American gas** cost structure is fundamentally changed by Shale Gas; low-cost supply dominates the landscape
- **US Ethane** infrastructure expanding to supply new facilities; however, an increasing cost structure will pull prices for incremental supplies higher
- **Coal price** declines resulting in high spreads to oil/naphtha – such differentials are needed to pay for higher capital required for CTO.
- **A sustained advantaged** for NAM natural gas and China coal versus crude oil will attract investment and shift the balance of new supply and product trade

Energy and Hydrocarbon Feedstock Costs: Key Drivers In Chemicals Manufacturing



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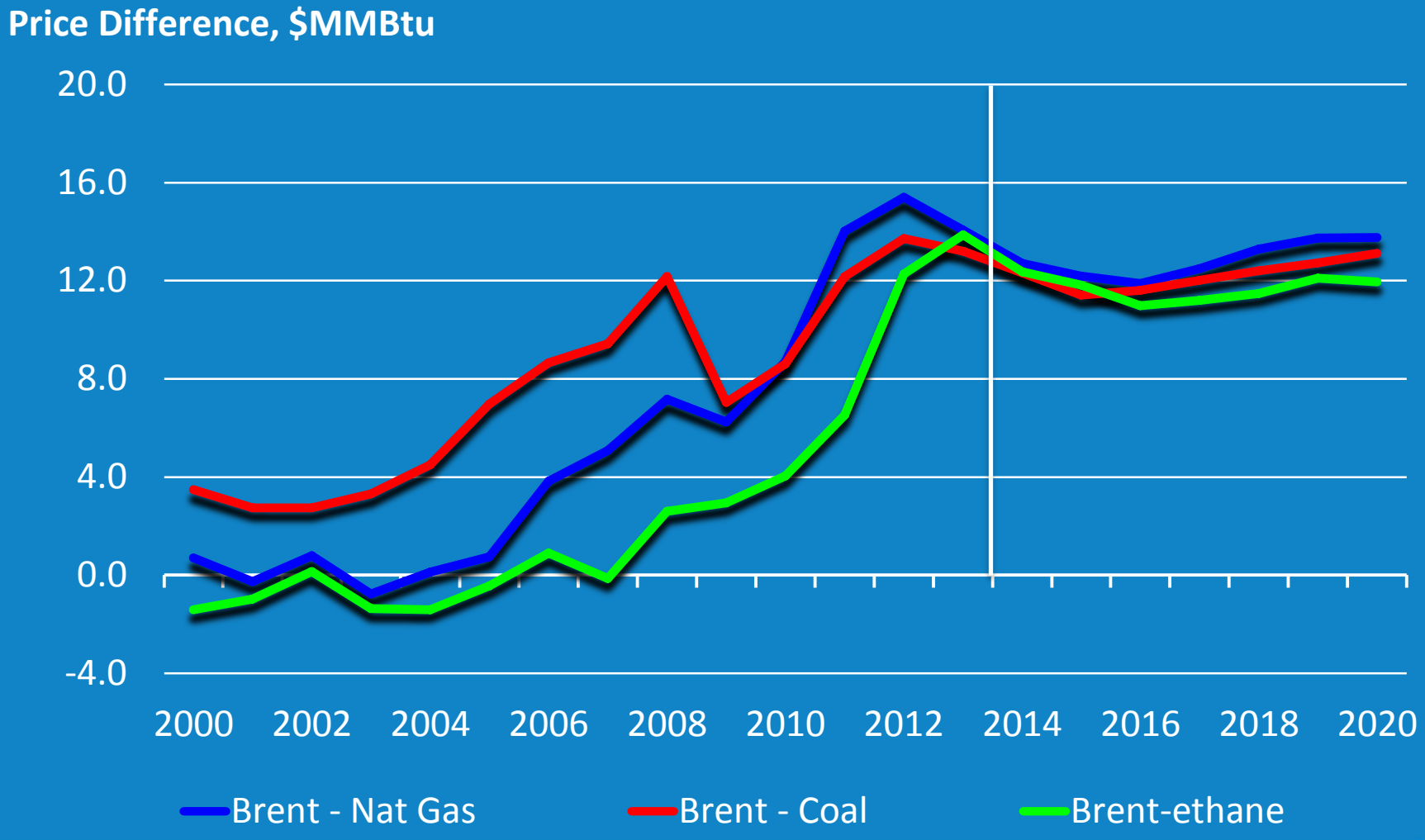
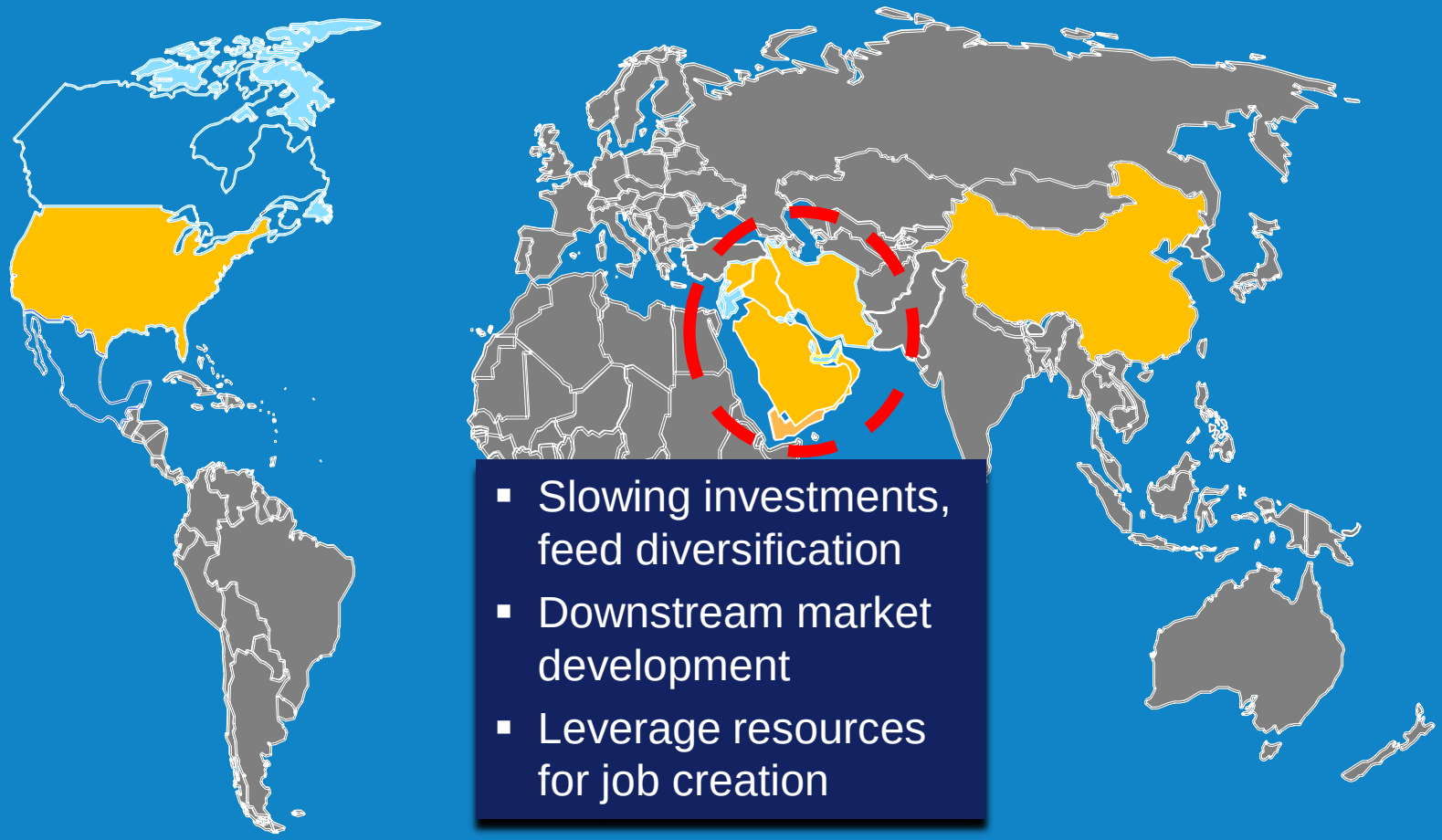
Feedstock Price Differentials vs. Crude Oil

Create opportunities in coal, gas, ethane



Three Regions with Different Markets all Focus on 'Advantaged' capacity



- Slowing investments, feed diversification
- Downstream market development
- Leverage resources for job creation

Middle East Industry Development Forged By Advantaged Feedstock……

Light Feedstock – C1/C2	Mixed Feedstock – C1/C2/C3/C4/Lt. Naphtha	Heavy feedstock – Naphtha (Market Linked Price)
Extremely High Margins – Substantially higher than industry average	Reduced Margins but still very competitive – Above industry average	Drastic reduction in margins -margins in line with marginal producers or even lower
Easy investment decision	Still relatively easy investment decision	**Competitiveness Challenged – Investment decisions relatively difficult**

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Kingdom of Saudi Arabia Chemical Landscape Continues to Evolve

Performance Plastics and Materials

Sadara

Engineering Resins and Rubber

SABIC

Nylon

Chevron Phillips Chemical Company LLC

Acrylics and SAP

TASNEE

MMA, PMMA, TPOs

Petro Rabigh

Emerging KSA Portfolio

HISTORICAL

Different Commodities
- Polyethylene
- Polypropylene
- Polystyrene

Commodities
- Ethylene Glycol
- Styrene

NEW

Performance Polymers
- ABS
- Synthetic Rubber
- Polycarbonate
- Polyacetal Resins
- Nylon 6
- C8 PE/Elastomers

Specialty Chemicals
- MDI/TDI
- Polyols
- EO/PO
- Amines
- Glycol Ethers
- Acrylate Monomers
- Epichlorohydrin

Source: Saudi Aramco

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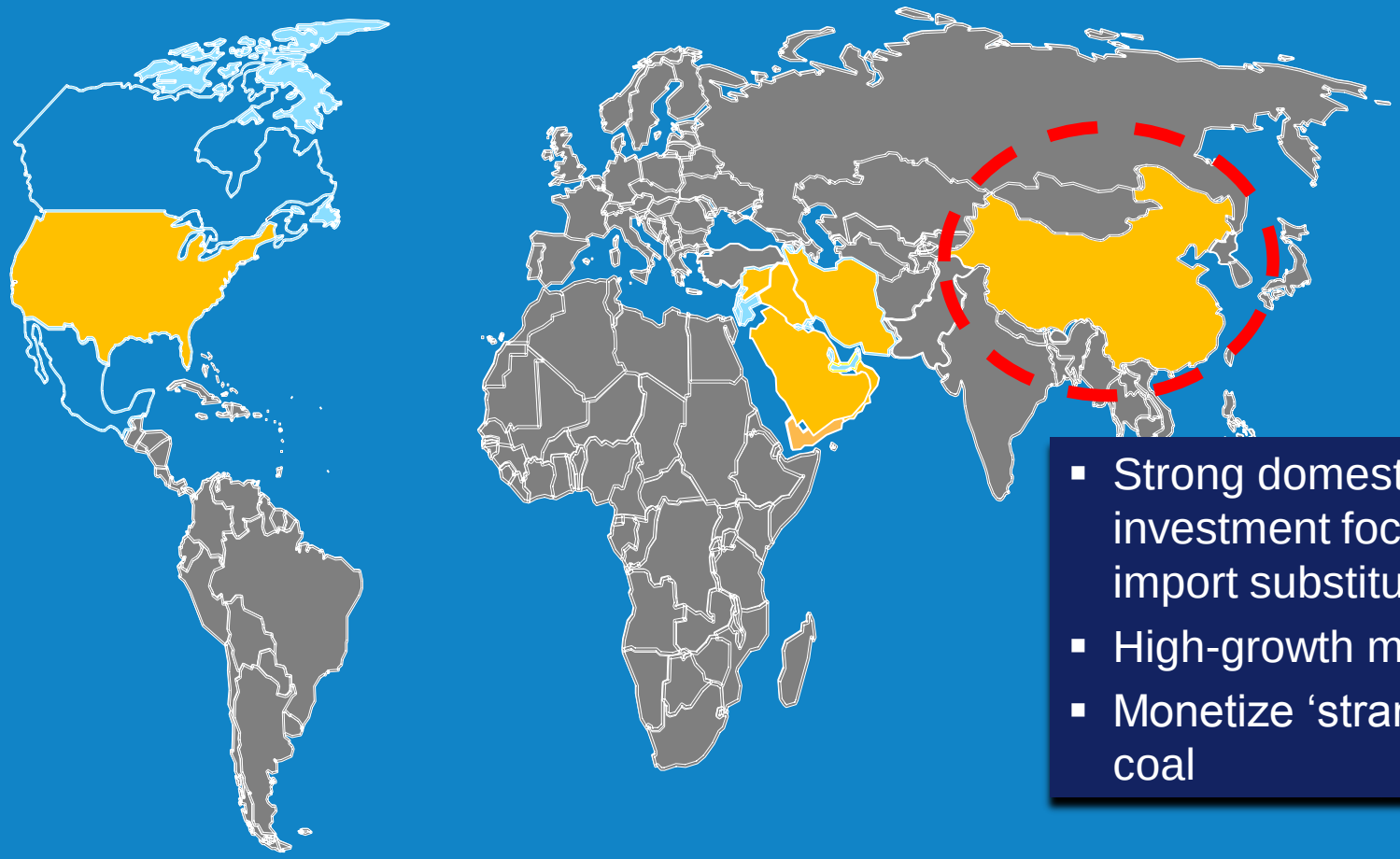
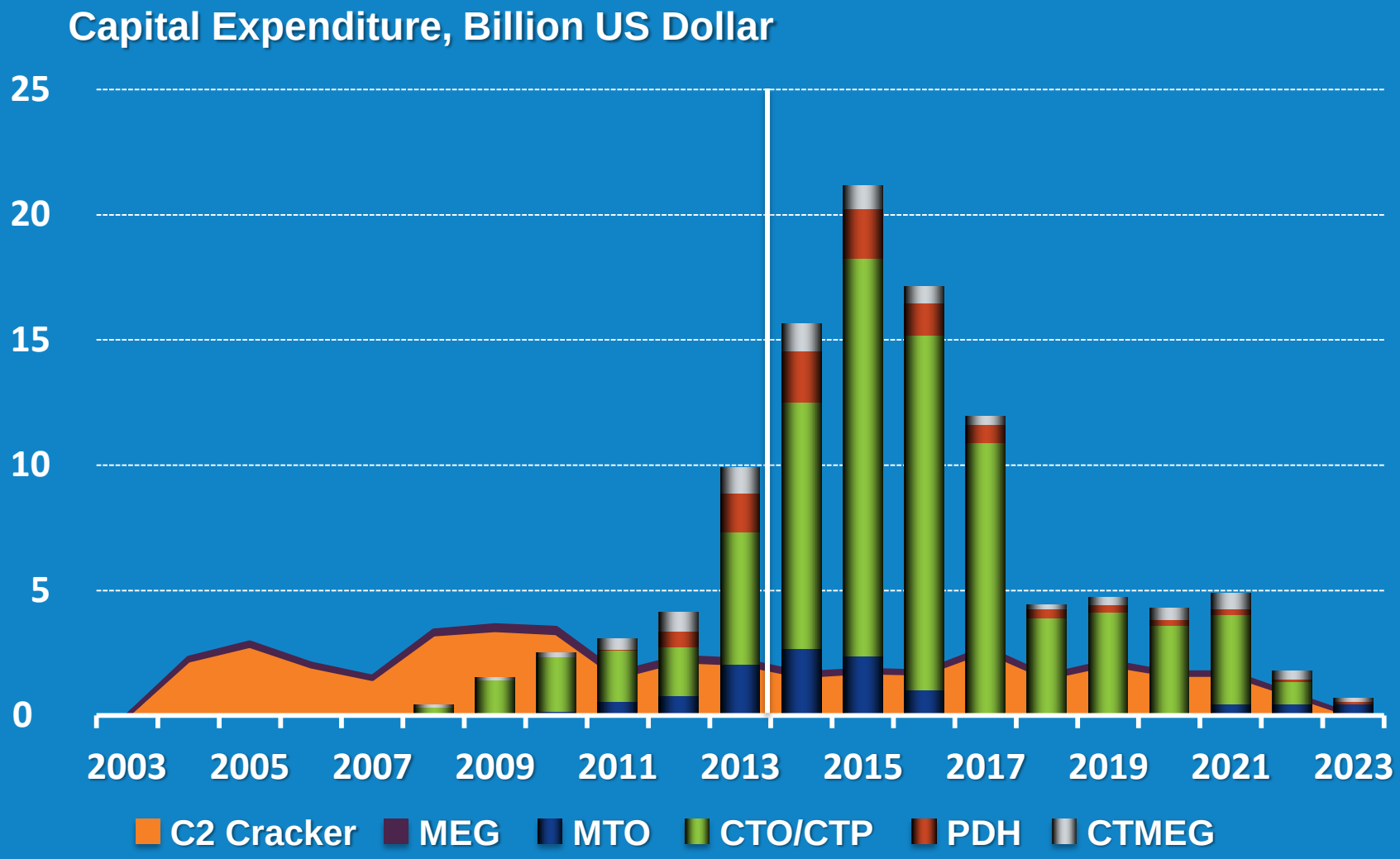
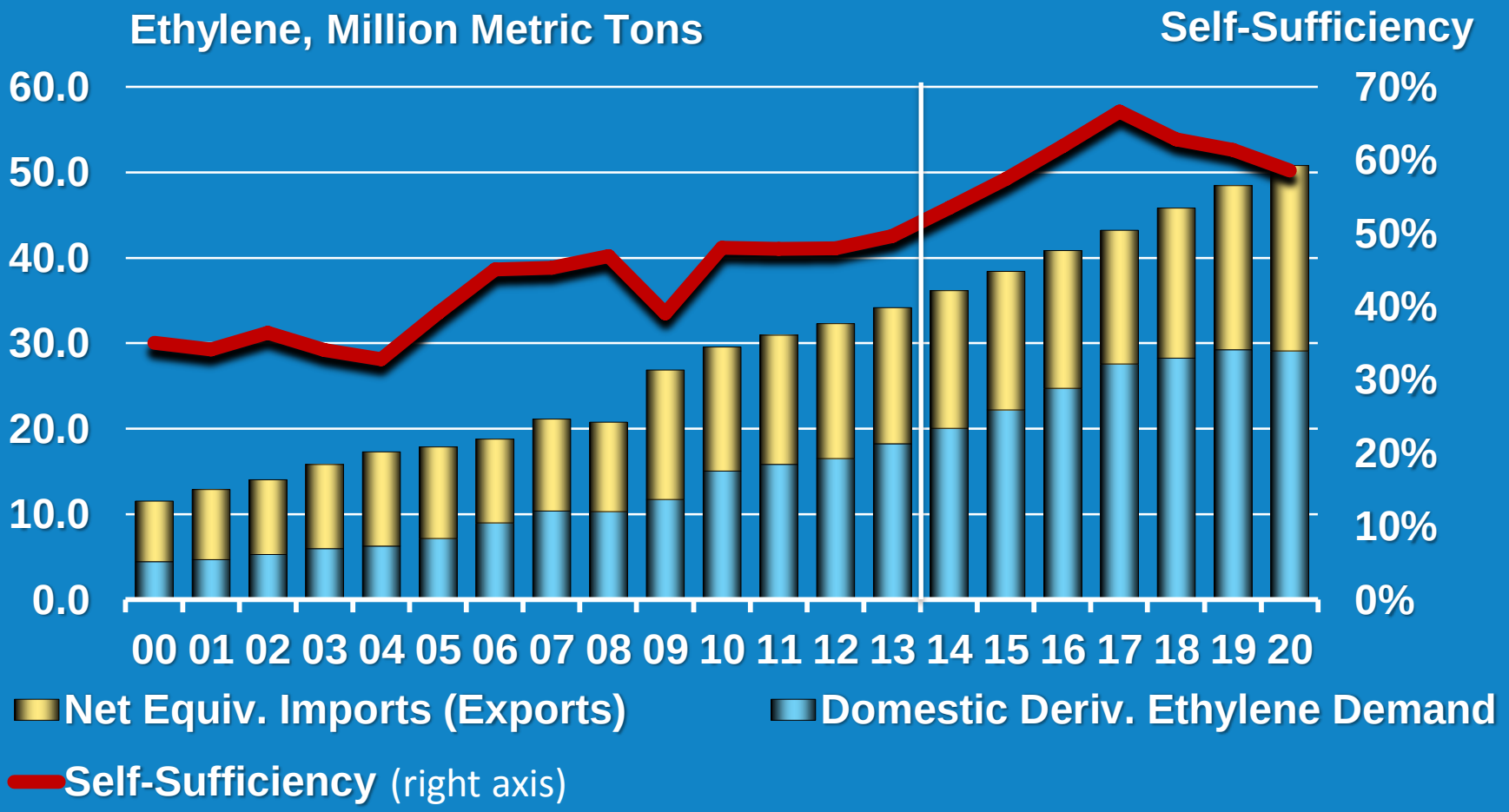


- Strong domestic investment focused on import substitution
- High-growth market
- Monetize 'stranded' coal

A Wave of Investment in China Seeking to Reduce Dependency on Imports



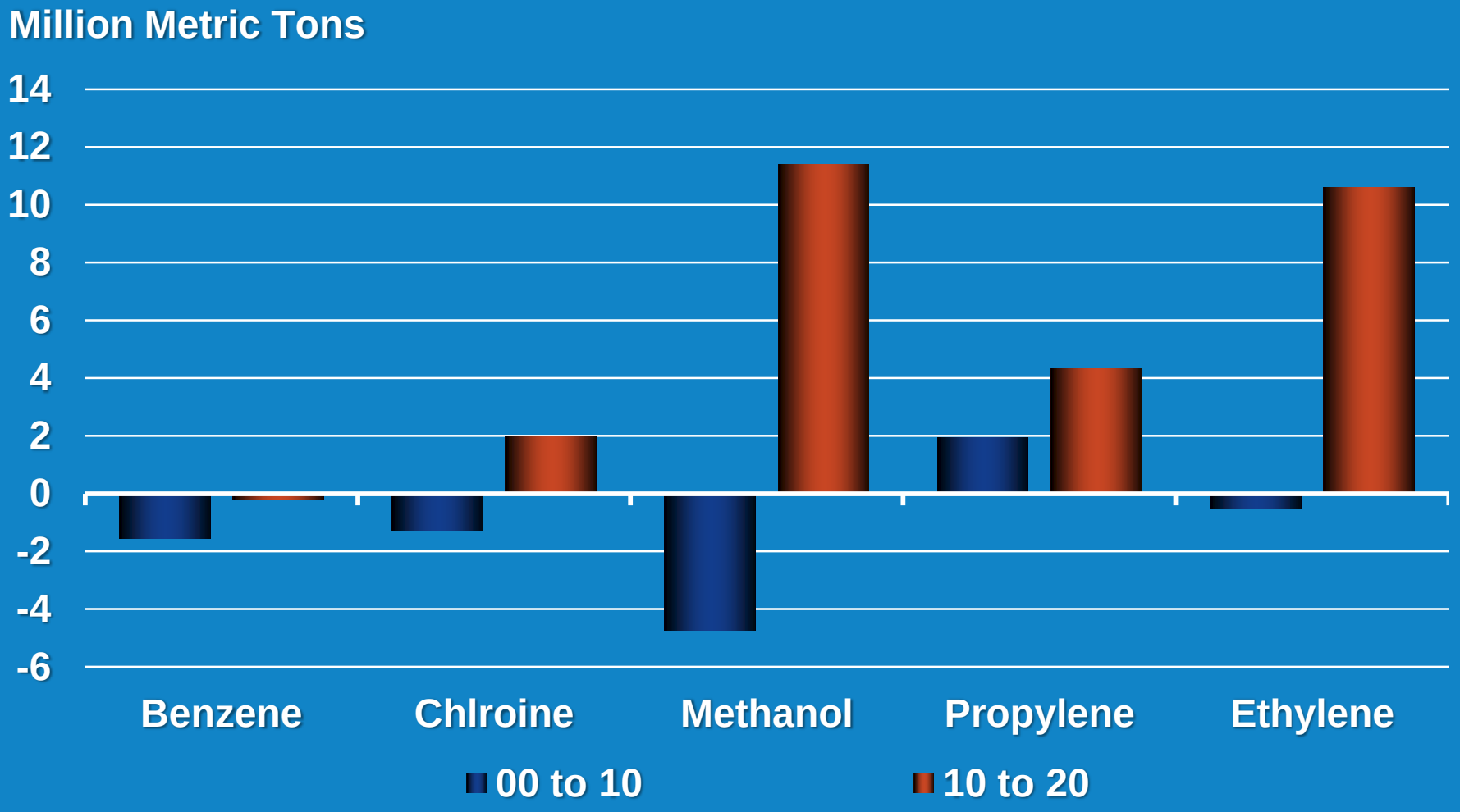
China Is Reducing Ethylene Derivative Import Dependencies



Three Regions with Different Markets all Focus on 'Advantaged' capacity

- Monetize shale resources
- Leverage to exports but service manufacturing renaissance
- CAPEX substantive concern

United States Basic Chemicals Growth
2000/2010 versus 2010/2020



Impact Of Shale Gas On North America Downstream Chemical Value Chains

Value Chains	Main Products	Investment 2000-2010 (Kta)	Investment 2010-2020 (Kta)	Downstream Derivatives	Quartile on Cost Competitiveness
C1	Methanol	-6,300	+17,200	Formaldehyde, Acetic Acid, VAM	Q1-Q2
	Ammonia	-7,000	+9,700	Urea, Nitric Acid, Fertilizers	
C2	Ethylene	+0.3	+13,800	PE	Q1-Q2
				EO/EG	
				PVC	
C3	Propylene	+1,831	+4,788	PP	Q1-Q2
				Oxo Alcohols, Acrylics, PO, ACN	
C4	Butadiene	+.91	+.32	Rubber, Dispersions	
				Oxo Alcohols, Plasticizers	
C6-C9	Aromatics	Declining	Declining	B: cumene; ethylbenzene	
				MX: PX; MX; OX	

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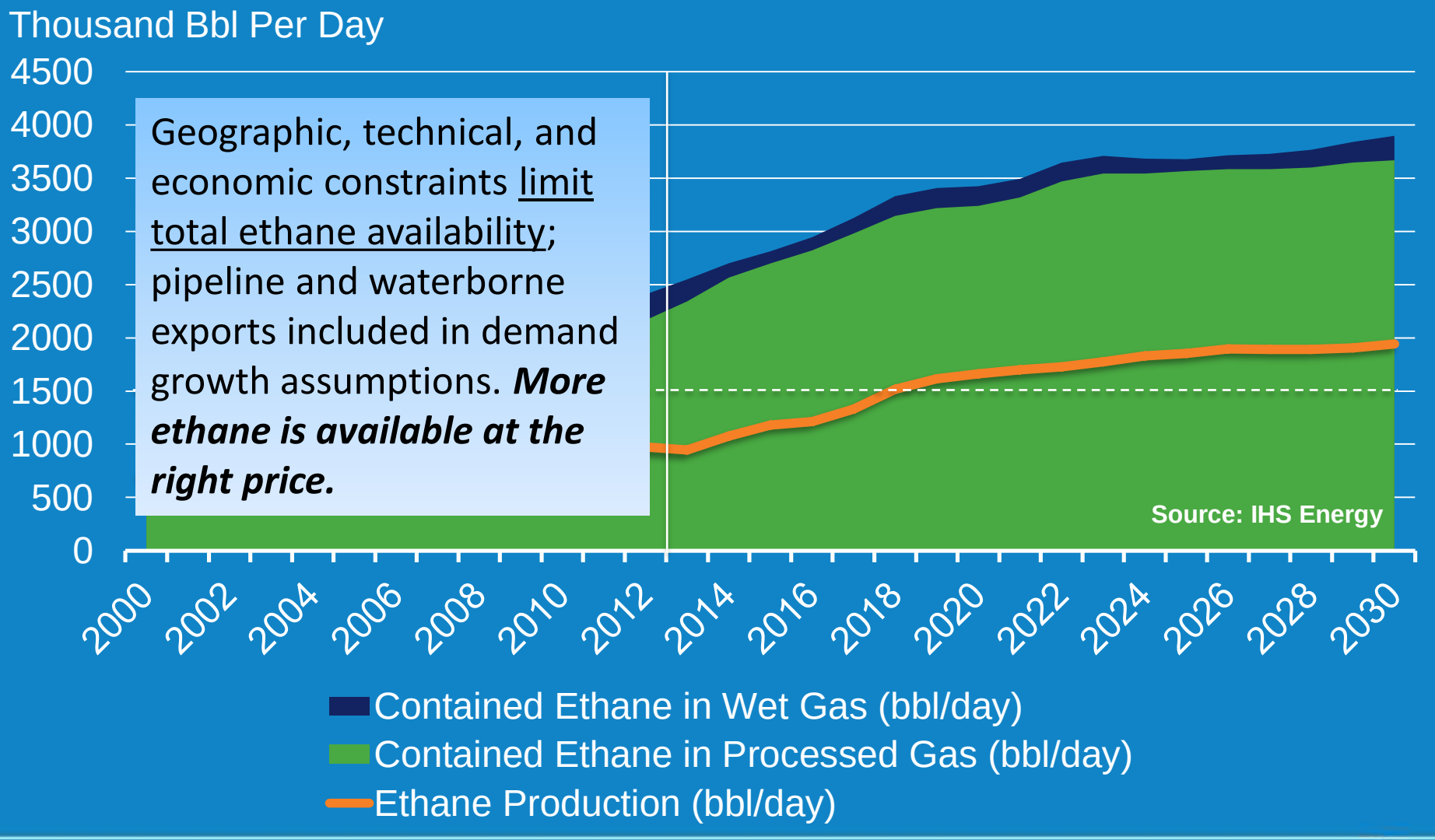
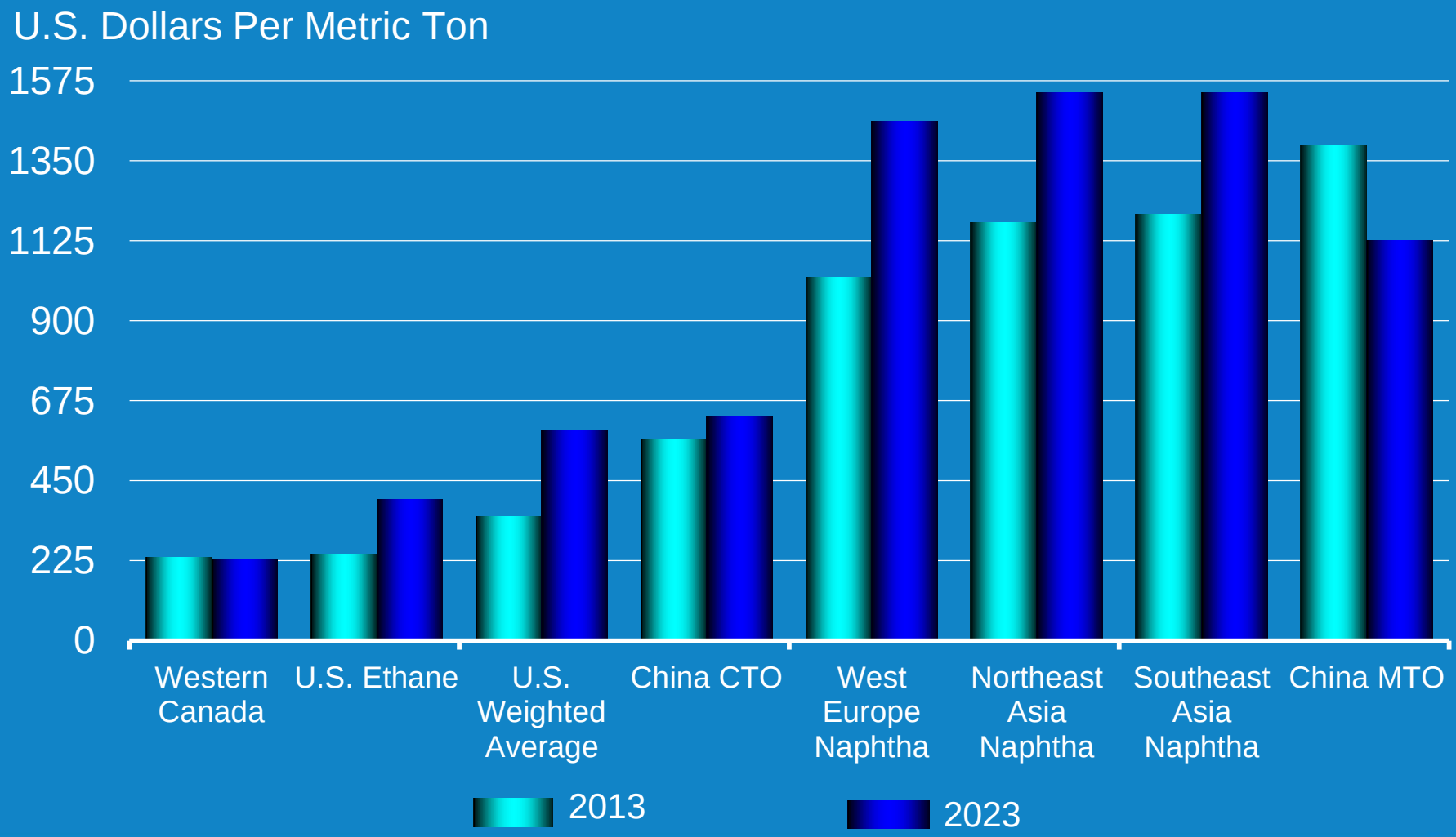
North America Ethane Production Forecast

Limited by logistics & economics, not by availability



Ethylene Cash Cost Snapshot

Regional Comparison: 2013 vs 2023



Unprecedented Ethylene Capacity Additions Driven By Low Cost Ethane Supplies

- North America forecast to start up more than 12 million tons of new ethane based ethylene capacity by 2020.
- Current wave of new capacity mainly built by existing producers; only two new companies.
- Braskem-Idesa scheduled to start up the first grass-roots ethylene unit since 2000.
- Peak additions forecasts to overlap in 2018/19, which could result in an oversupply scenario

Ethylene Capacity Additions		
Projected North American Ethylene (Thousand Metric Tons per Year)		Total Additions 2014 - 2020
Company	**Location**	
BASF/Total	Port Arthur. TX	**170**
ChevronPhillips	Cedar Bayou, TX	**1,500**
Dow	Freeport, and Plaquamine	**1,720**
Eastman	Longview, TX	**17**
Equistar	All Locations	**862**
ExxonMobil	Baytown, TX	**1,500**
Flint Hills	PT Arthur	**100**
Formosa	Point Comfort, TX	**1,150**
Oxy/Mexichem	Ingleside, TX	**550**
Sasol	Lake Charles, LA	**1,550**
Westlake	All Locations	**216**
Williams	Geismar, LA	**1,758**
Braskem Idesa	**Mexico**	**1,000**
Nova	Sarnia	**168**
	Total:	**12,261**

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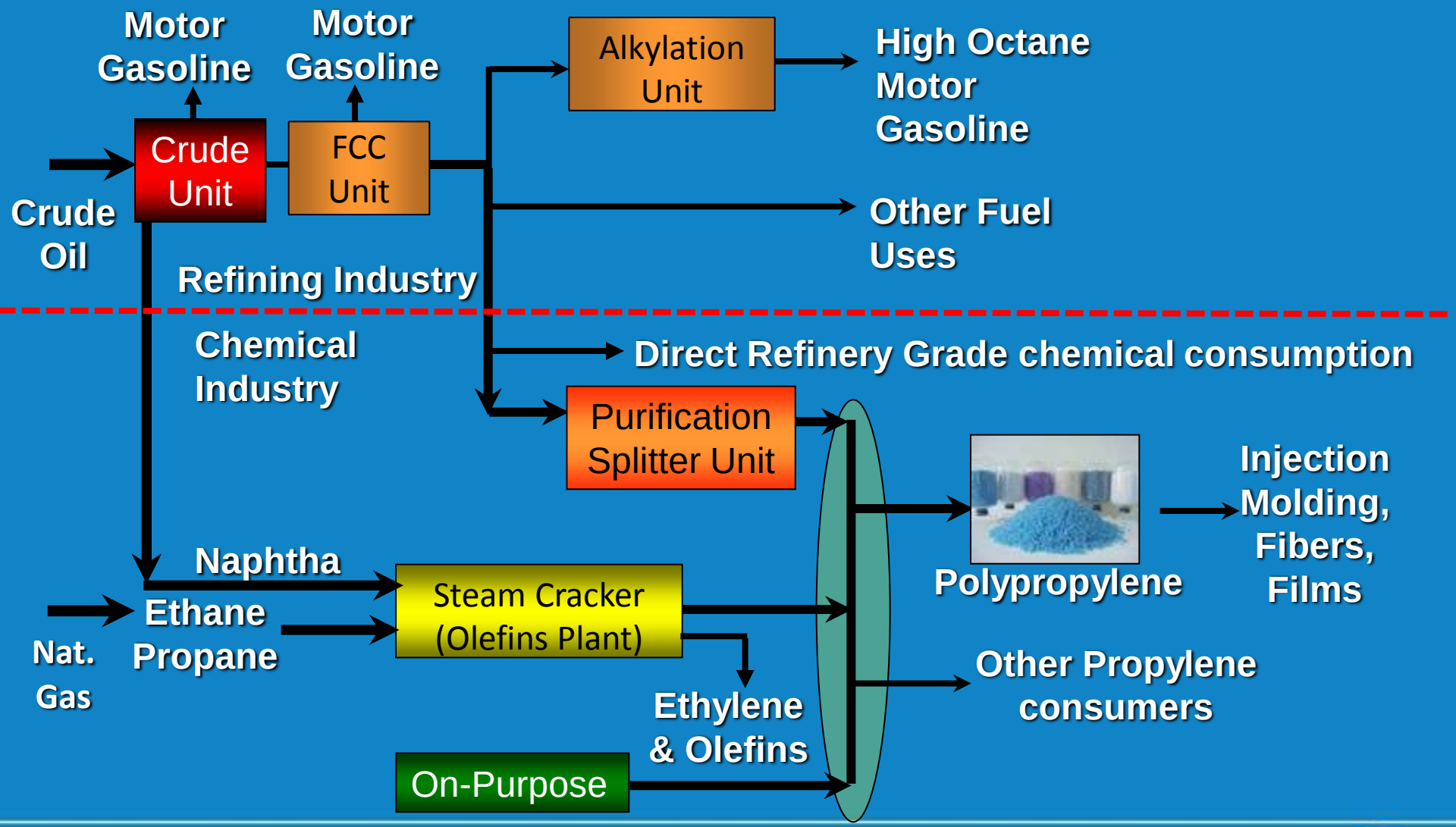
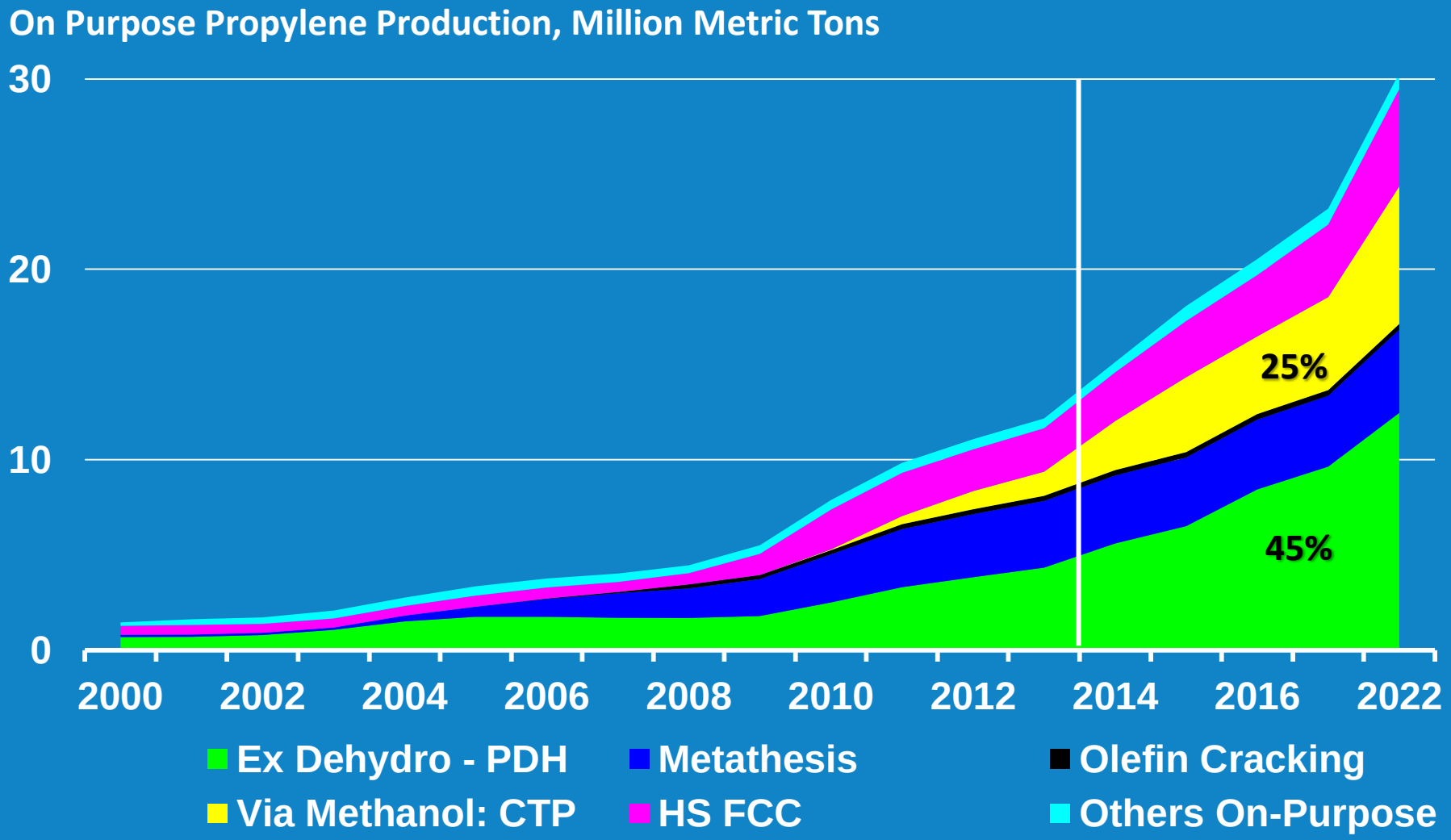
Three Routes to Produce Propylene



On-Purpose Propylene Production Trends
PDH & CTP Investments Accelerate

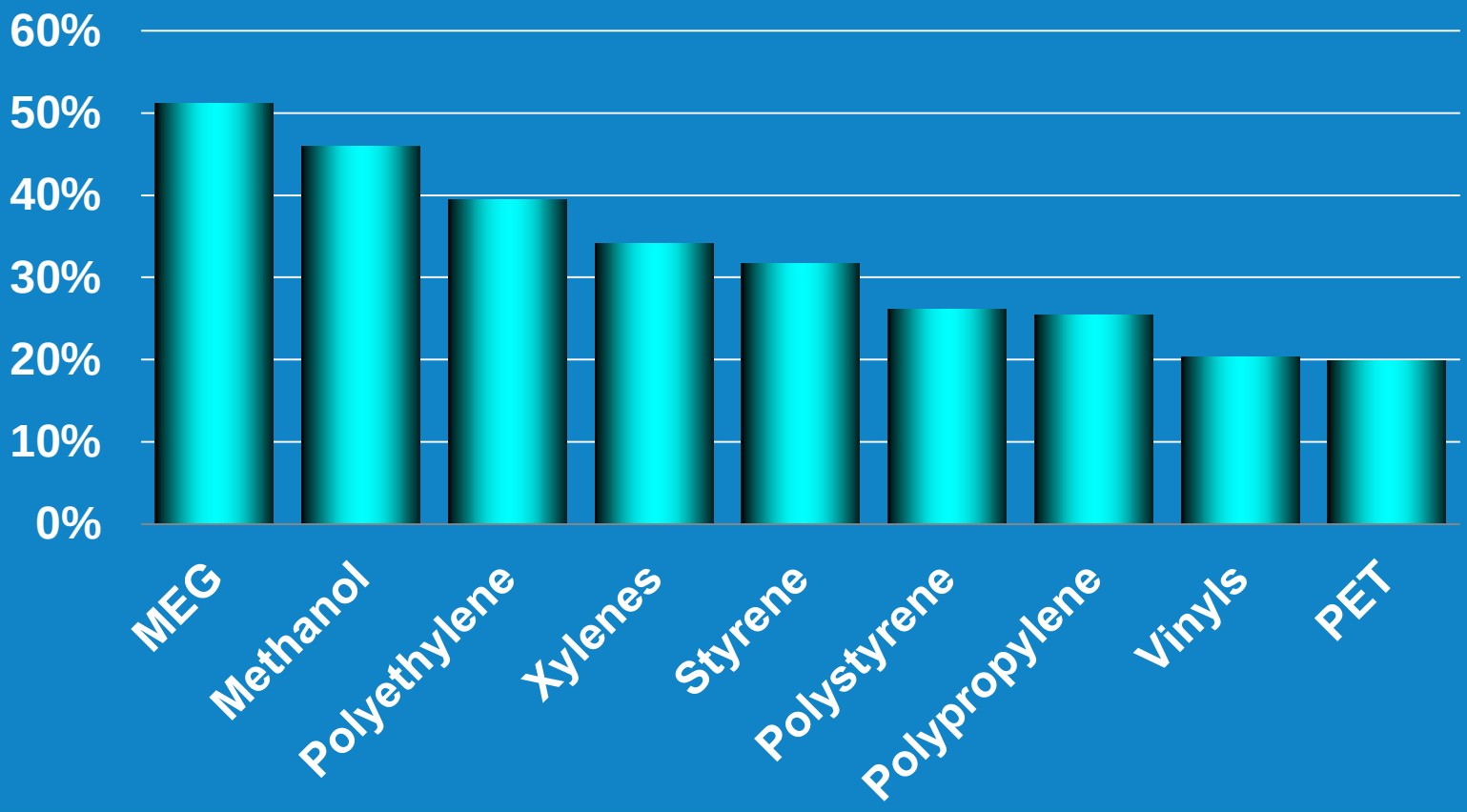


Trade Patterns Will Continue To Evolve

- Investment in advantaged feedstock regions will push trade volumes higher connecting resource-rich geographies with higher growth markets
- Significant infrastructure investments are needed to expand capabilities to meet future demand growth in trade volume.
- Supply-chain expertise and well crafted go-to-market strategies will increase in importance.
- The pressure on high-cost producers servicing markets targeted by advantaged capacity will intensify.
- Finished goods trade patterns are also shifting, as supply-chain efficiency requirements change and cost structures evolve

2020 Exports & Total Trade
Basic Chemicals & Plastics

% 2020 Production Exported



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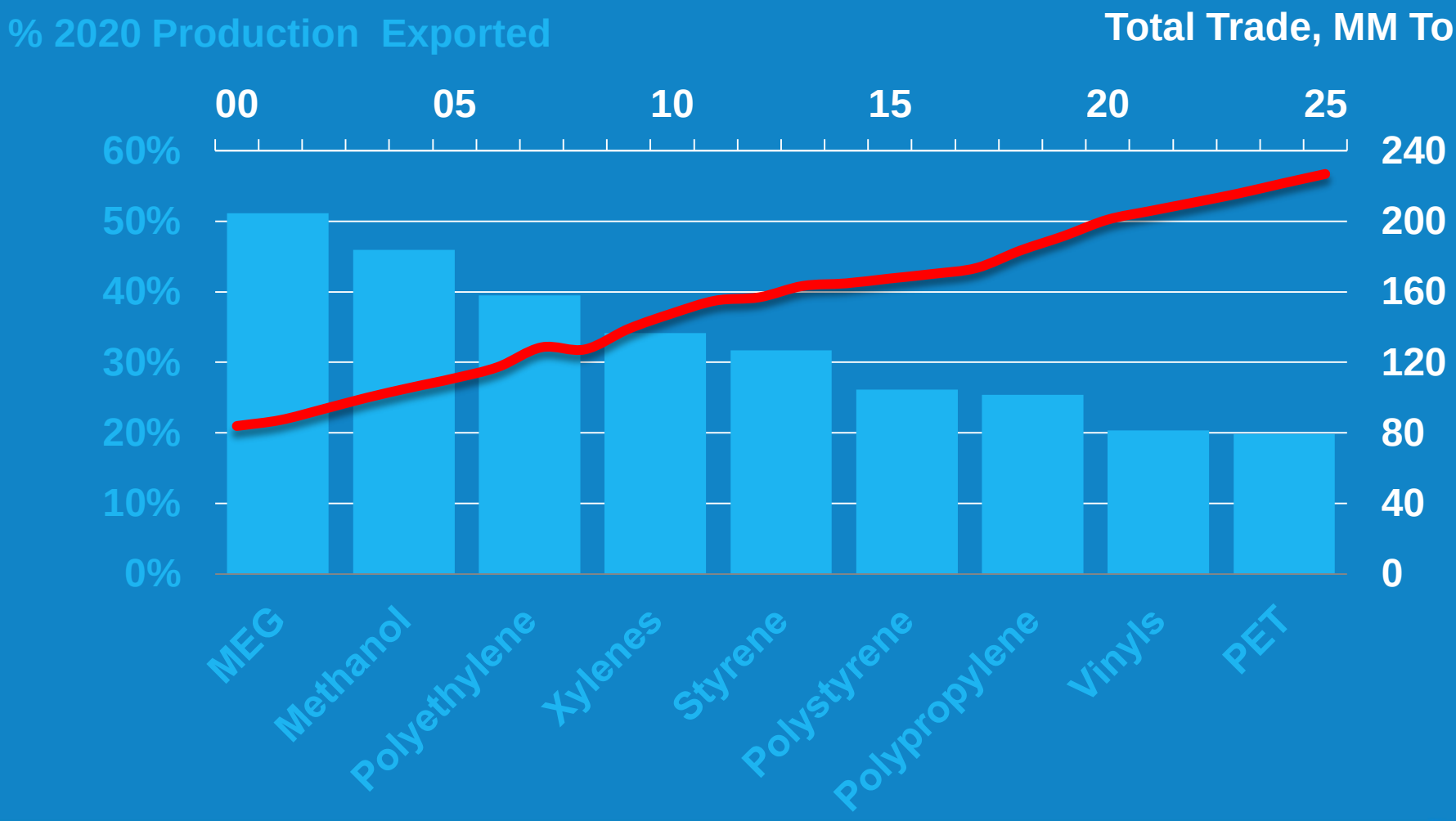
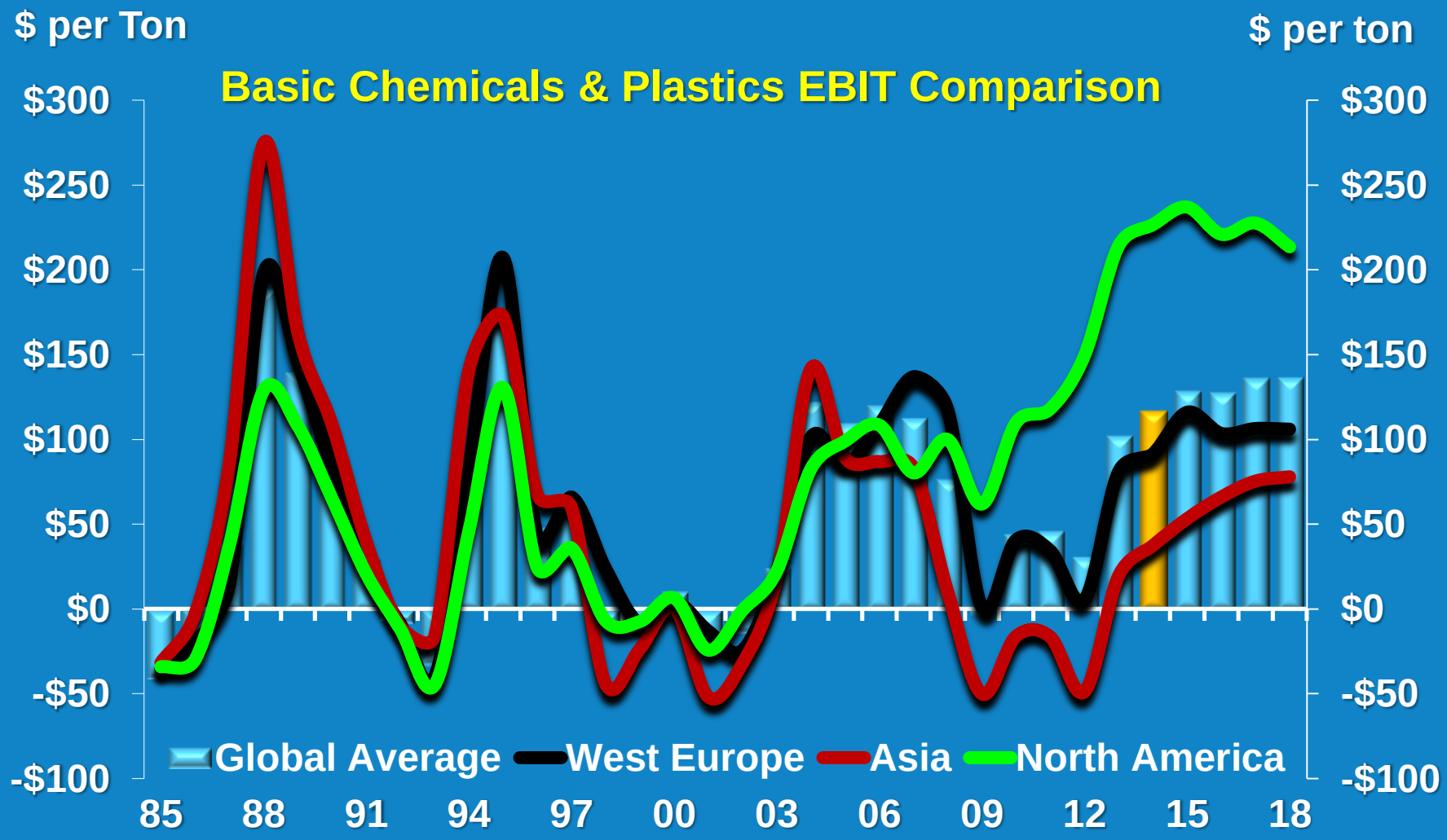


Profit Cycle &

Finished Goods Manufacturing

- **Chemical industry profitability** greatly influenced by value-chain and regional access to low-cost energy and feedstocks. Significant pressure builds on high cost "crude-based" technologies and regions
- **Downstream manufacturing** expected to grow in North America for products with a high "supply-chain intensity", enabled by sustained low energy and renewed chemicals investments

Global Profit on the Upswing; Down-Cycle Muted for Advantaged Regions



Supply Chain Intensity (SCI) Drives Future Decisions for Manufacturing

Off-shoring

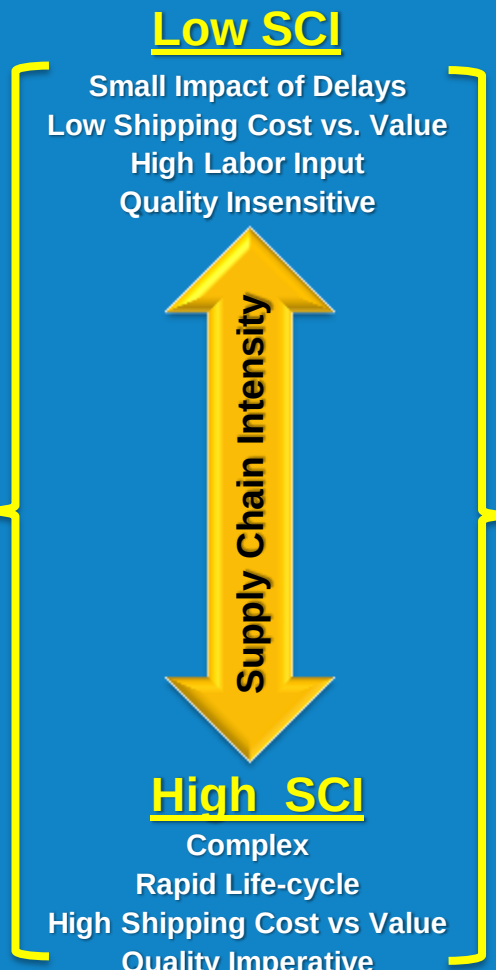
Shift to low-cost locale distant from end market

Near-shoring

Shift to medium-cost locale co-regional or proximate to end market

On(re)-shoring

Return local supply & services to the domestic market



Apparel – Glycol, Polyester, Nylon

Footwear- PU, EVA, SBS

Furniture – PU, (Outdoor - PP, HDPE)

Appliances – PP, ABS, Nylon, PU, PS, PC

Electronics – ABS, PC, PBT, POM, Nylon

Autos & Assemblies - PP. PU, PBR, Nylon, PC, ABS

Aerospace – Carbon Fiber, Epoxy, PEEK

Final Thoughts… …Base Chemical Producer Perspective

What Could Be Different?

Upside Influences

- Economic strength
  - Level and duration
- Constraints on new assets or existing supply
  - Capital costs, skilled labor, unplanned outages

Downside Influences

- Economy slowdown/crash
  - China, Eurozone, US
- Energy price shock
  - Crude flow or natural gas disruptions
- Logistics/trade flow constraints
- Geopolitical chaos

Un-expected Events

- Government action; regulation, trade barriers, market subsidies
- Environmental Health & Safety Impact
- New technology developments

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THANK YOU !!

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