



Global Energy Markets & Alberta

Leveraging the Alberta legacy to attract new waves of petrochemical industry investment

BUILDING ALBERTA'S INNOVATION AND INVESTMENT

18th Annual Stakeholder Luncheon

Thursday, January 19, 2017

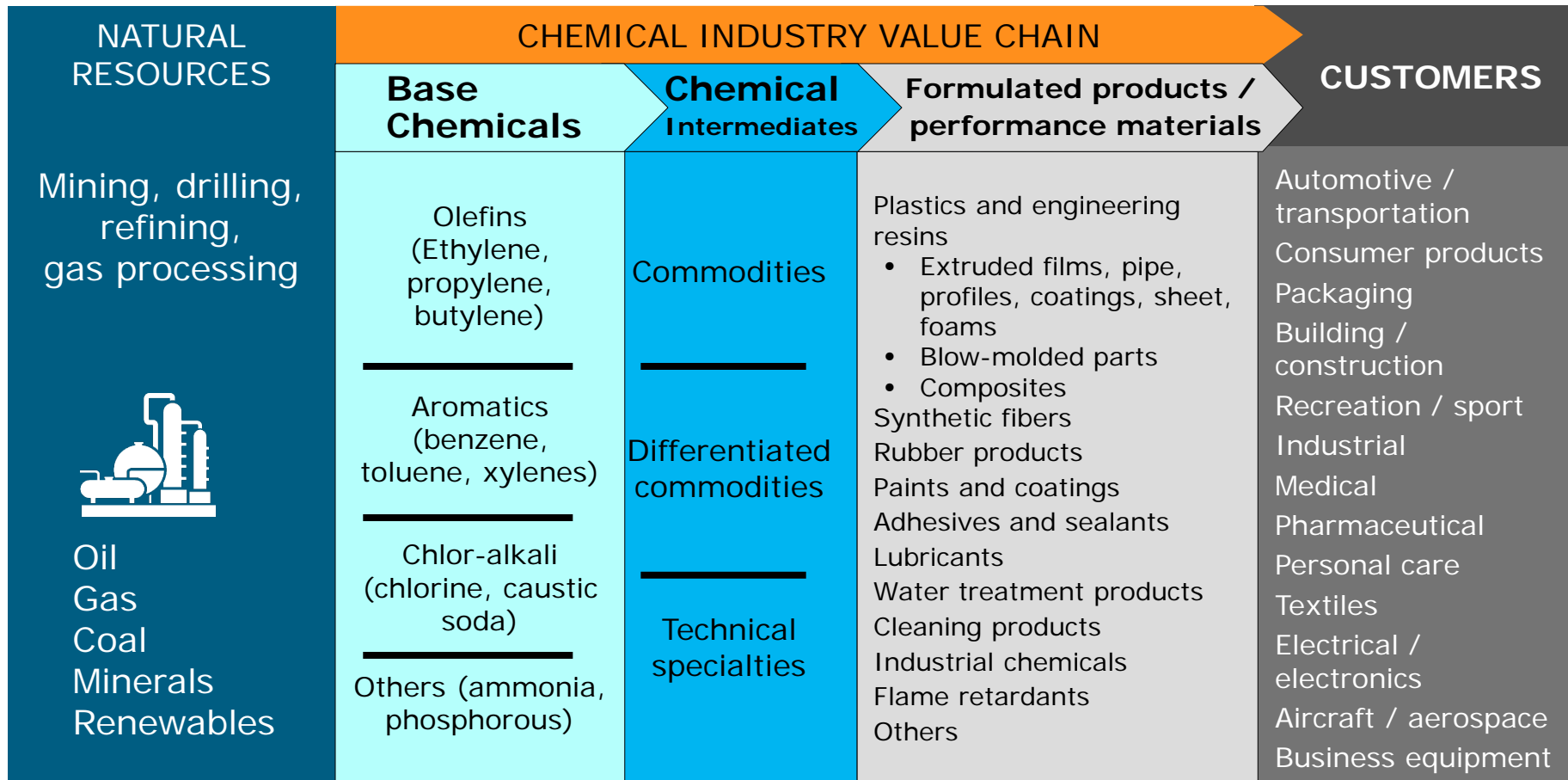
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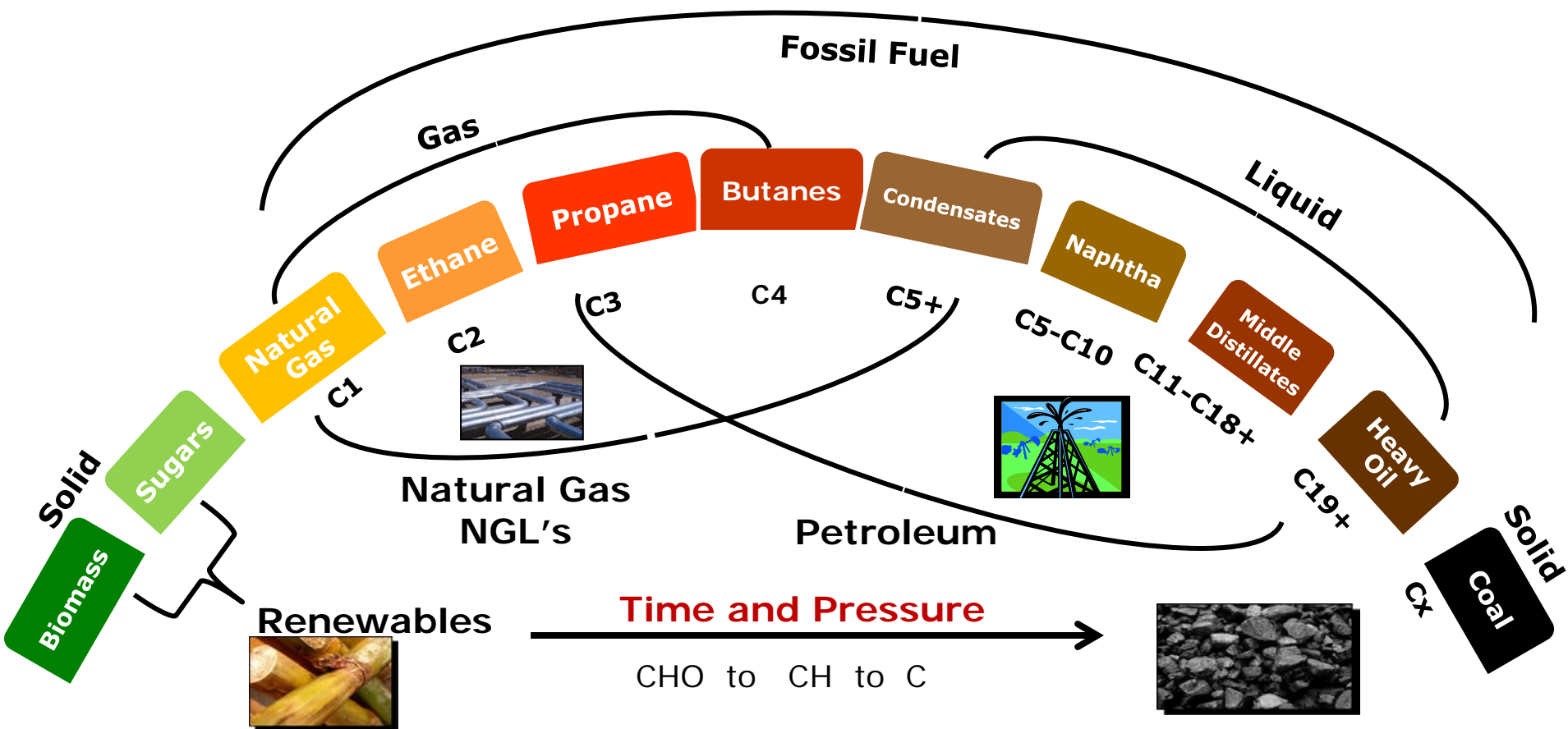
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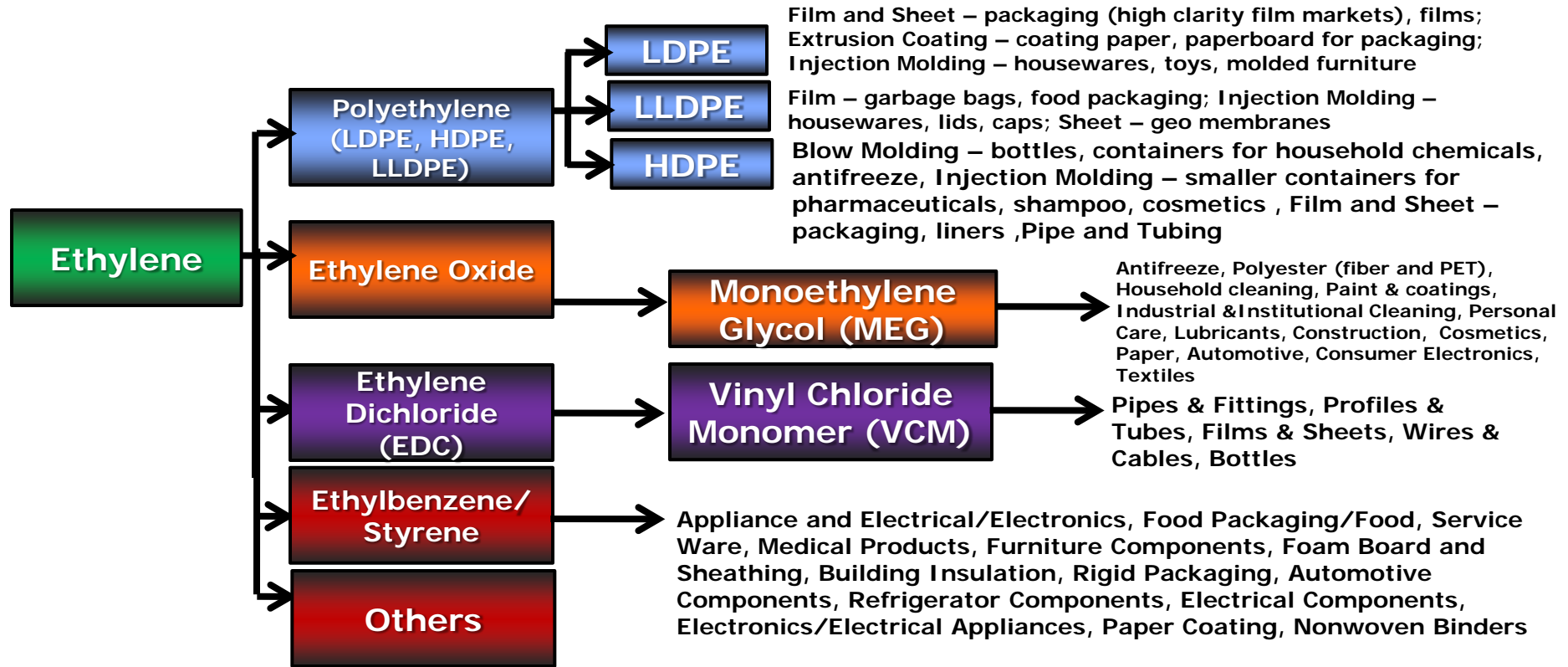
GLOBAL CHEMICAL INDUSTRY... ENABLING MODERN LIVING



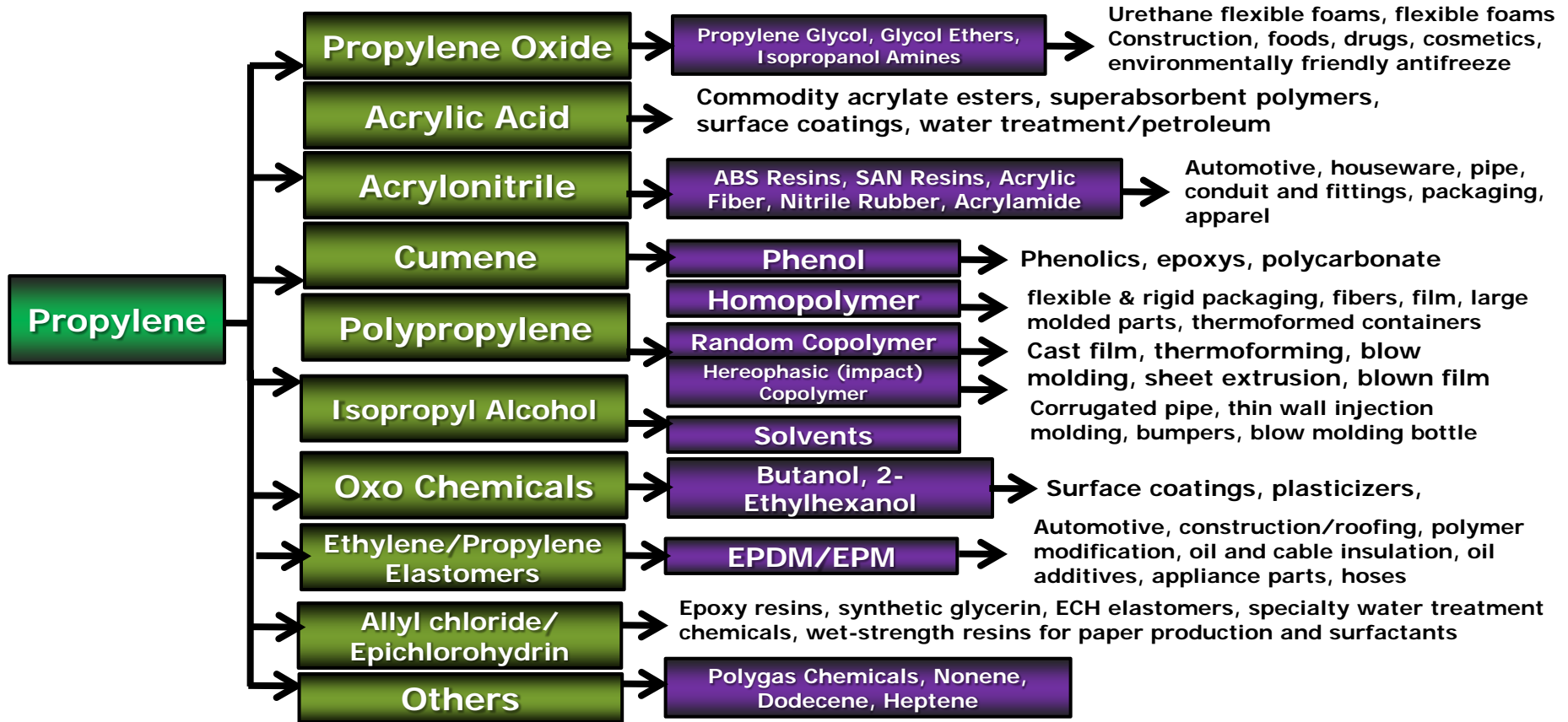
Petrochemical Feedstock Palette



Ethylene Value Chain



Propylene Value Chain

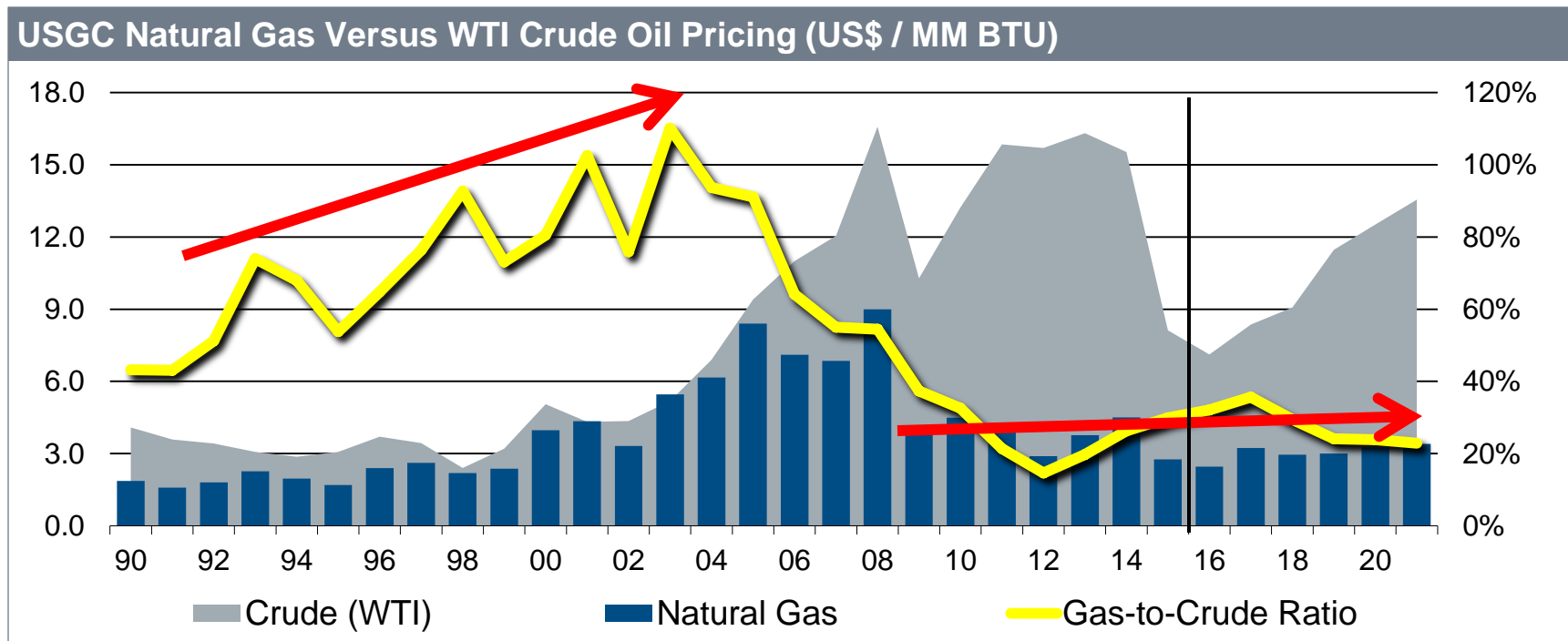


Energy & Economic Fundamentals Impact Investment Decisions

- **Energy trends** impact regional competitiveness and profitability
- Advantaged investments in North America, Middle East and China see **lower margins in low crude oil** market. “Advantaged” companies are focused on operational efficiencies in the current environment.
- Economy and energy assumptions **drive key investment decisions** of location, feedstock, technology, scale...
- Uncertainty results in **delayed approvals**; when combined with steady growth leads to tighter market conditions in basic chemical value-chains
- **Crude oil (energy) “at the extremes”** impacts demand for chemicals and plastics. On the high end, it can “destroy” demand and on the low end it can stimulate demand. Creates variability in the forecast.

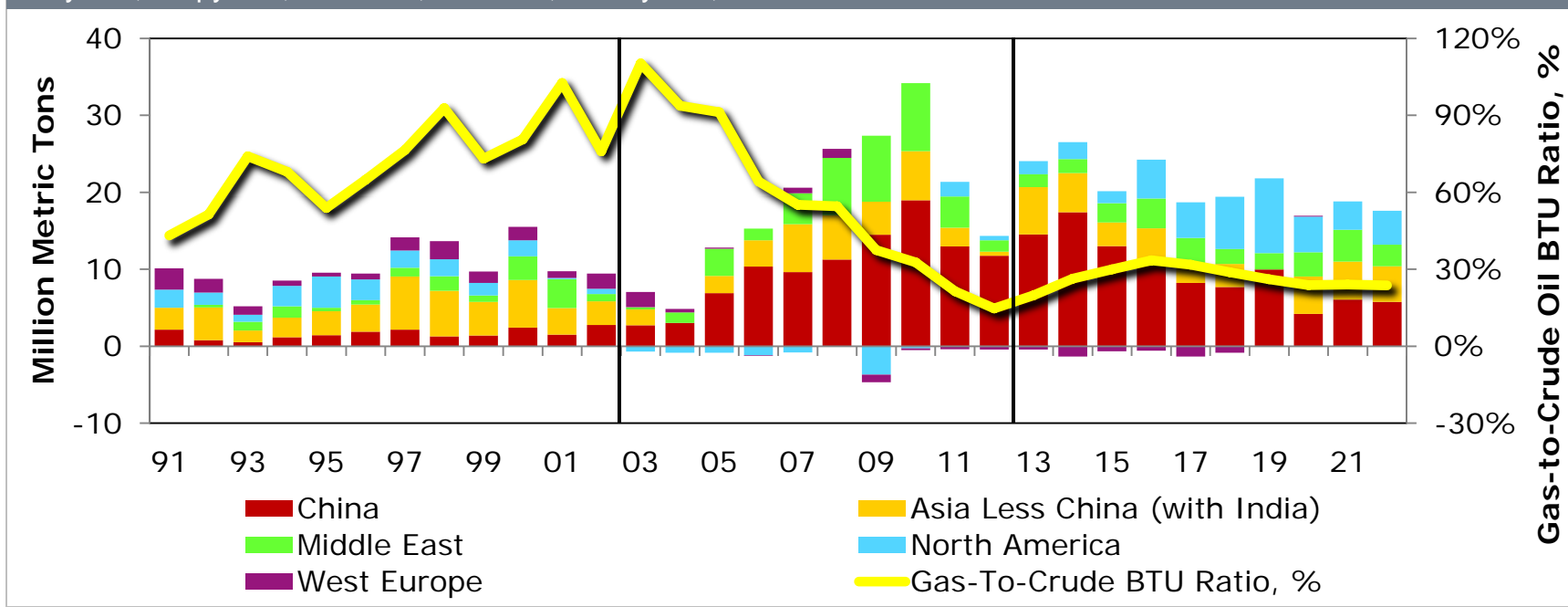


Gas-to-Crude Ratio Favors North America Investments Since 2010



Impact of Changing Energy Dynamics On Regional Chemical Capacity Additions

Annual Change - Total Basic Chemicals Capacity:
Ethylene, Propylene, Methanol, Benzene, Paraxylene, Chlorine



Investment Decisions, *Made Years In Advance*, Consider Many Factors Beyond Energy & Economy

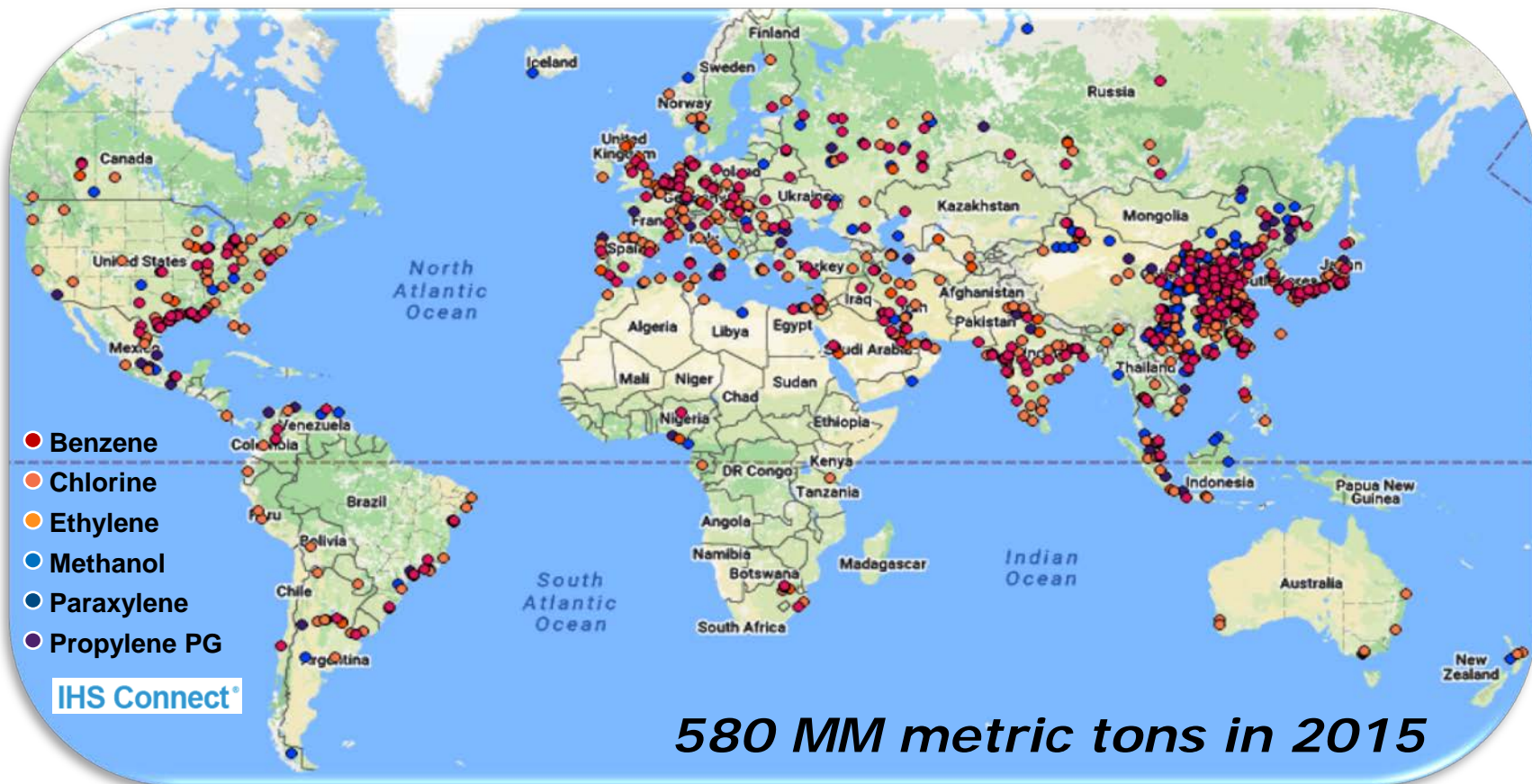


**Braskem-Idesa Ethylene/PE Plant
Nanchital, Veracruz, Mexico
Start-Up: June 2016**

Investment Drivers/Assumptions:

- Crude oil/energy price trends
- Global economic growth
- Geo-political considerations
- North American energy market
- State of industry profit cycle
- China structural changes
- Non-conventional technology
- Sustainability
- Levels of integration
- Regional CAPEX differentials
- Logistics investments
- Evolving Technology and Impact on Consumer Products & Markets

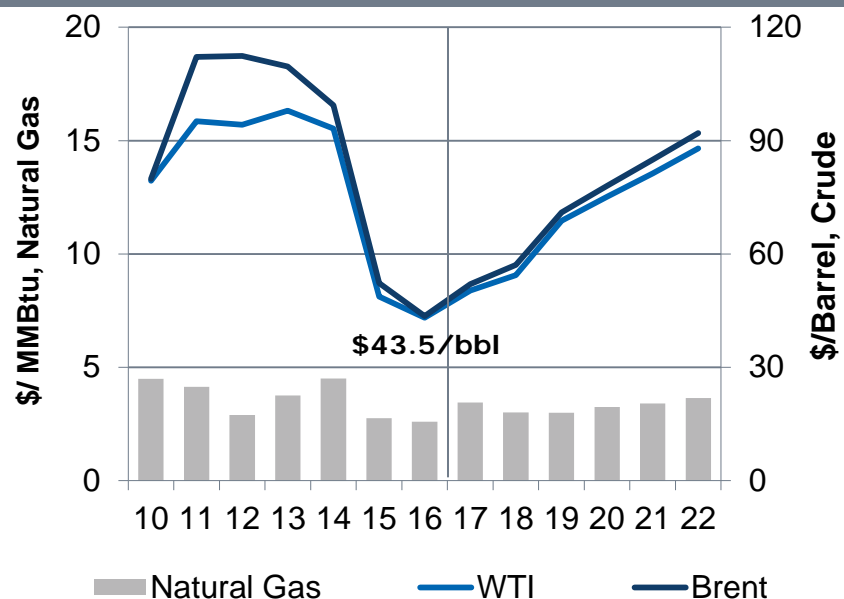
GLOBAL BASE CHEMICAL ASSETS BY LOCATION



IHS Markit BASE CASE PLANNING SCENARIO:

Steady Increase In Crude Oil Price; Stable/Low Natural Gas In North America; Moderate Global Economic Growth

Global Crude Oil vs. USGC Natural Gas



Source: IHS

© 2016 IHS

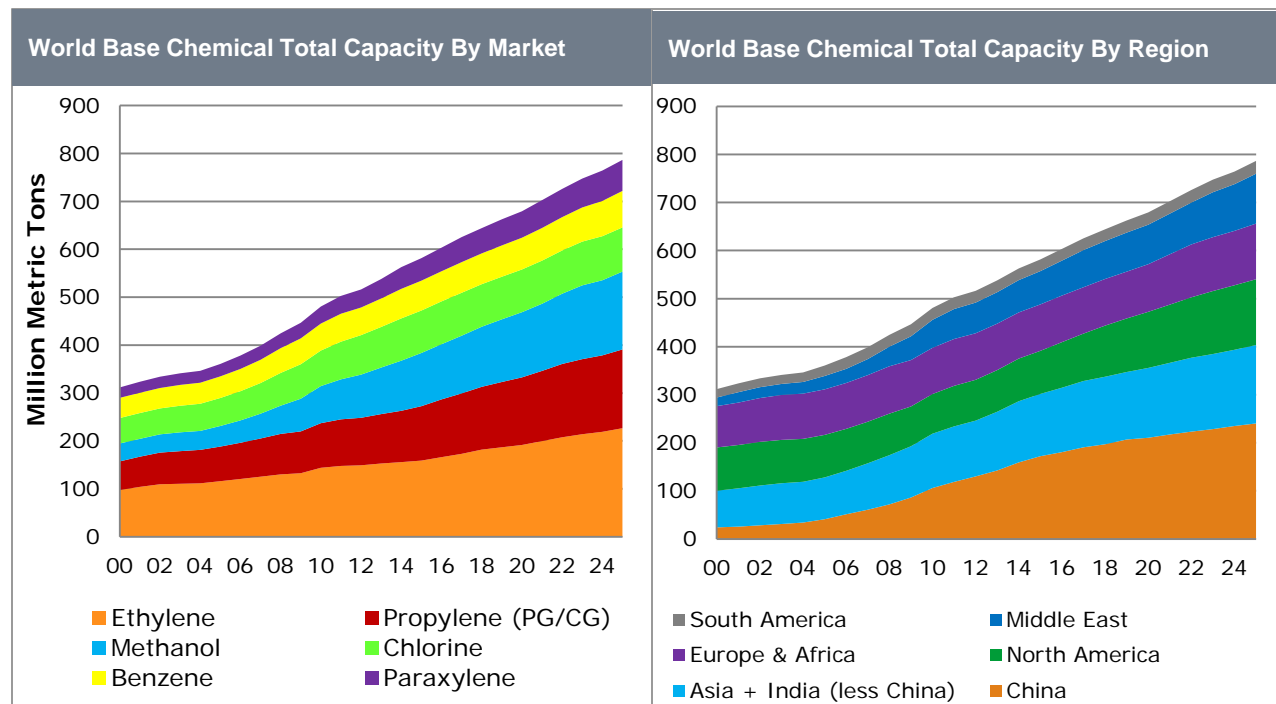
% Change, GDP

	2014	2015	2016	2017	2018
World	2.7	2.7	2.5	2.8	3.0
United States	2.4	2.6	1.5	2.2	2.2
Canada	2.5	1.1	1.2	2.0	2.2
Eurozone	1.1	1.9	1.6	1.4	1.6
United Kingdom	3.1	2.2	2.1	1.2	1.2
China	7.3	6.9	6.7	6.4	6.4
Japan	-0.1	0.6	0.7	0.7	1.0
India	7.2	7.5	7.5	7.5	7.7
Brazil	0.1	-3.9	-3.3	0.5	1.9
Russia	0.7	-3.7	-0.6	0.8	1.6

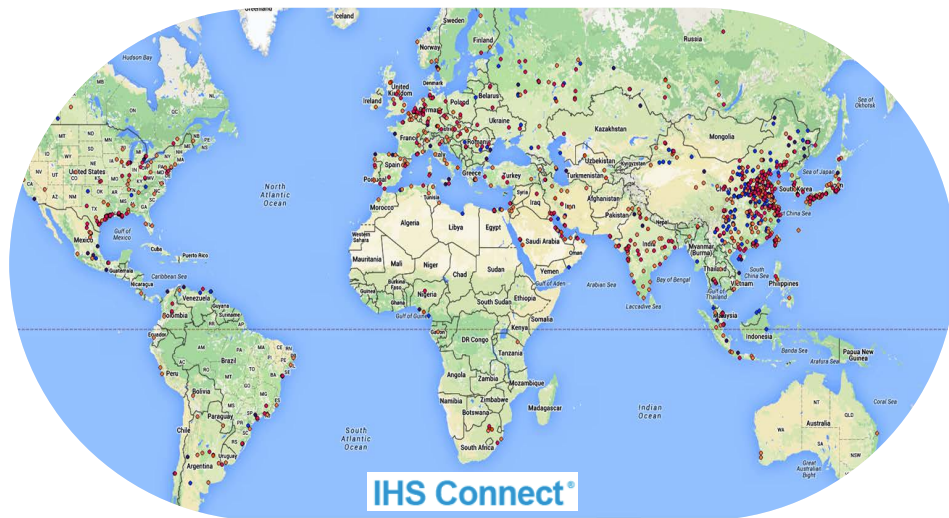
Base Chemical Capacity To Approach 800 MM Metric Tons By 2025: Ethylene, Propylene & Methanol Drive Growth

Chemical Investment “Drivers”

- Secure an energy & feedstock advantage.
- Leverage current technology and build world-scale.
- Invest with proximity to local markets and/or access to trade routes.
- Build to leverage an upstream and/or downstream integrated position.



Beyond 2020...Where Will The Next Wave Of Capacity Be Built?



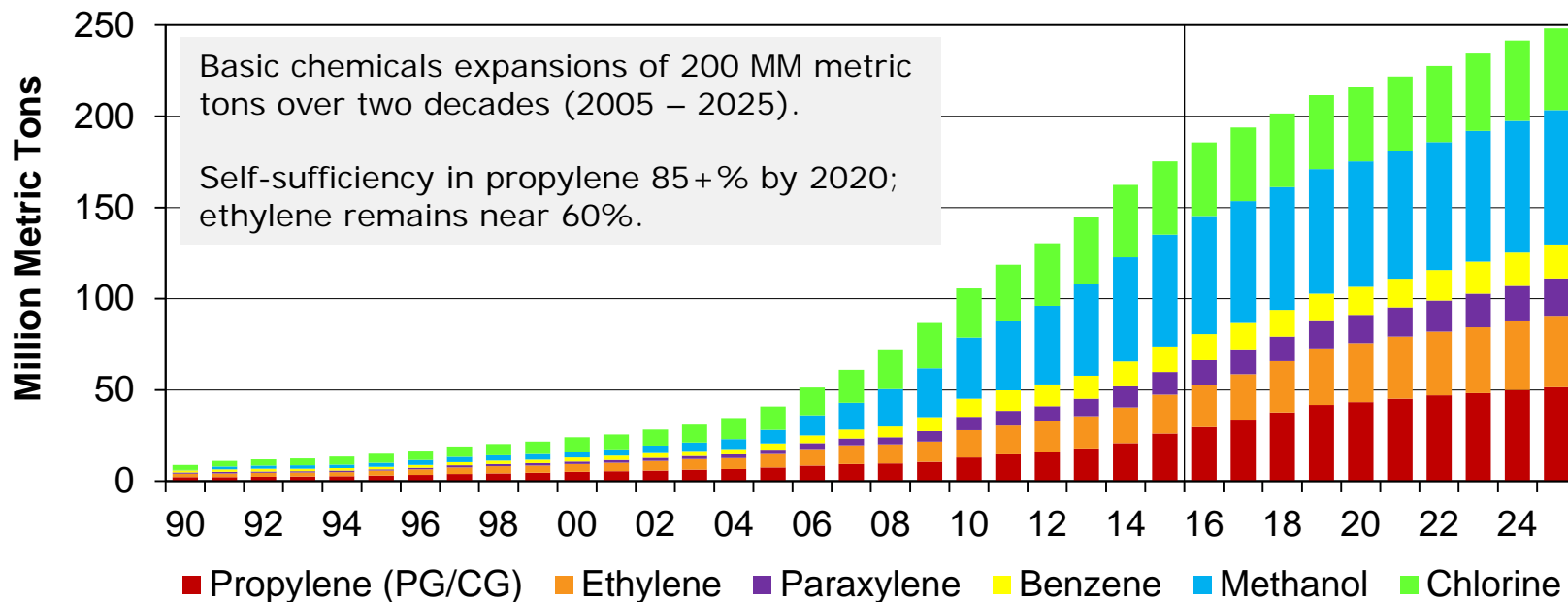
Total Basic Chemical* Capacity
(Million Metric Tons)

Region	2015	2025	Delta
North America	90	137	47
South America	24	26	2
Europe	89	101	12
Middle East / Africa	77	119	42
Asia/India (less China)	130	163	33
China	172	241	69
Total	582	787	205

* Ethylene, Propylene, Methanol, Benzene, Paraxylene, Chlorine

China 13th 5-Year Plan Slows Pace Of Investment; Focus On Competitive Position, Safety & Pollution, Consolidation

China - Base Chemical Total Capacity

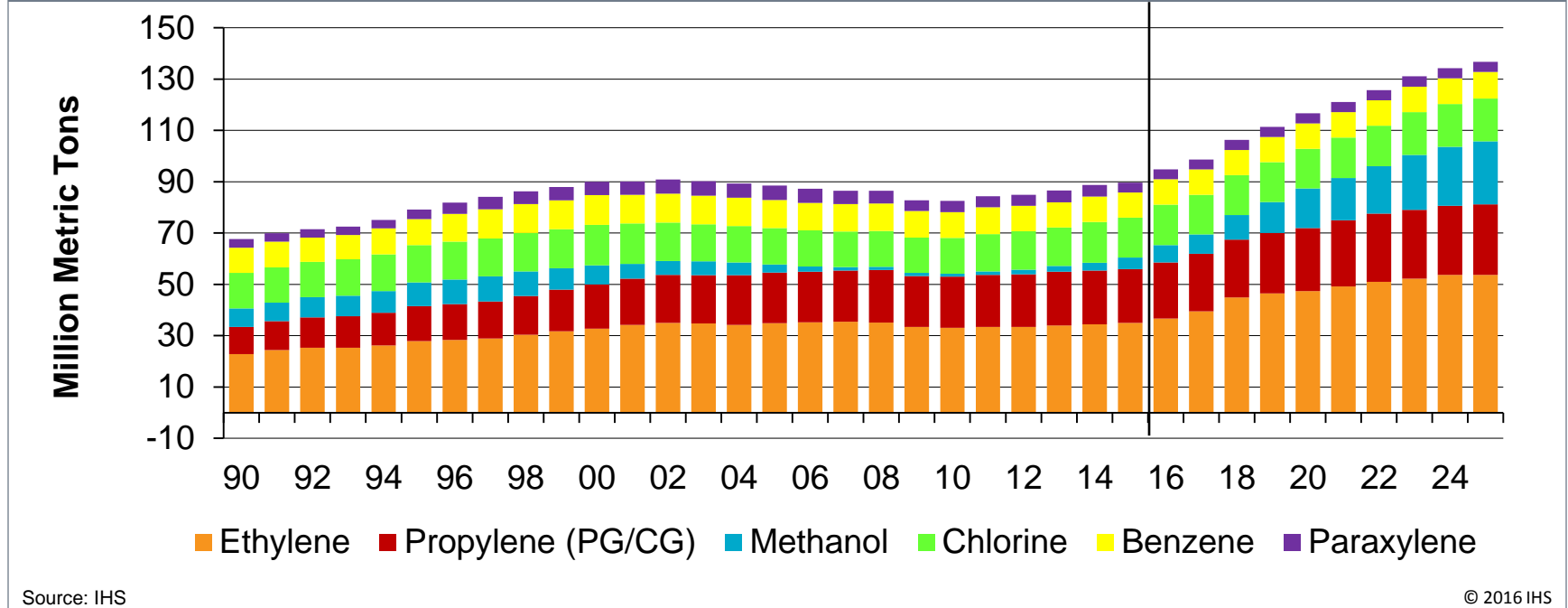


Source: IHS

© 2016 IHS

North America Low Cost Brings Back Base Chemical & Associated Derivative Investments

North America - Base Chemical Total Capacity



Source: IHS

© 2016 IHS

North America Investments Accelerate; US has majority of CAPEX; “Alberta” pursuing FID’s once again; Mexico new unit in 2016



Strategic Growth Trends

- Low cost energy and natural gas liquids provide sustainable advantage.
- Domestic and International companies seek to invest in the region.
- Logistics & port infrastructure investment is underway.

Risks & Disruptive Forces

- High CAPEX & poor project execution.
- Chemical feedstocks a function of methane demand.
- Anti-free-trade sentiment disrupt legacy of build-low-cost and export; NAFTA ??
- Environmental group anti-fracking.
- Potential for methane chemistry to be successful as a primary route to light olefins.

Energy At The Extremes Has Catalyzed A “New Era” In Light Olefins Production



Ethylene

CTO = Coal to Olefins
MTO = Methanol to Olefins
GTO = Natural gas to Olefins
OCM = Oxidative Coupling of methane to ethylene



Propylene

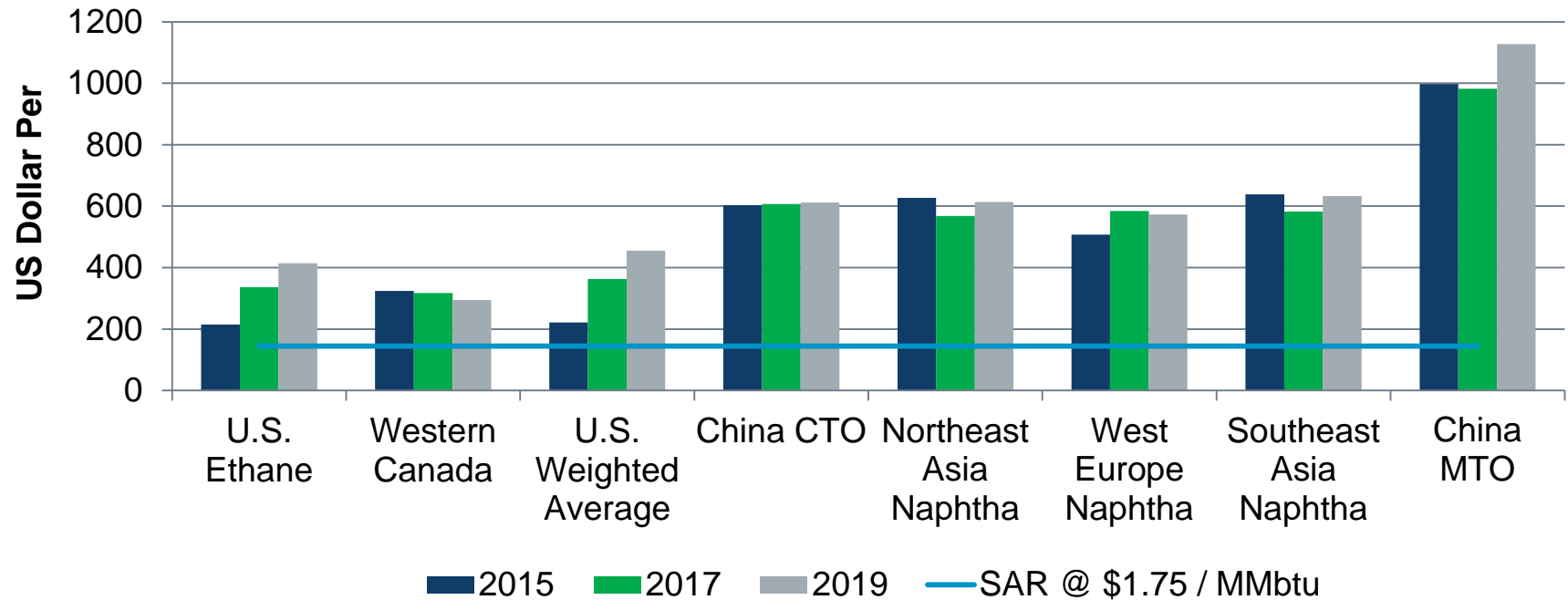
PDH = Propane Dehydro
CTP = Coal to Propylene
MTP = Methanol to Propylene
GTP = Natural gas to Propylene

- Light olefins supply based on refinery & naphtha cracker integrated sites in past.
- Ethane crackers emerged where ethane was advantaged; USGC, Mexico, Alberta, Middle East; other areas where liquids rich gas was “trapped”.
- Propylene was a byproduct of refining and heavy or flexible steam cracking.
- Today light olefins are being made on purpose via a variety of technologies beyond refining and steam cracking: PDH, CTO/P, MTO/P, Metathesis, GTO/P, OCM(methane).
- A high crude oil prices in the long term will enable more on-purpose, leaving C4= & higher hydrocarbons with future supply issues

Ethylene Cash Cost Snapshot

Saudi Arabia increase, US ethane advantage of \$250 plus versus NEA

World Ethylene Cast Cost Comparison



Ethylene Market

Key Issues

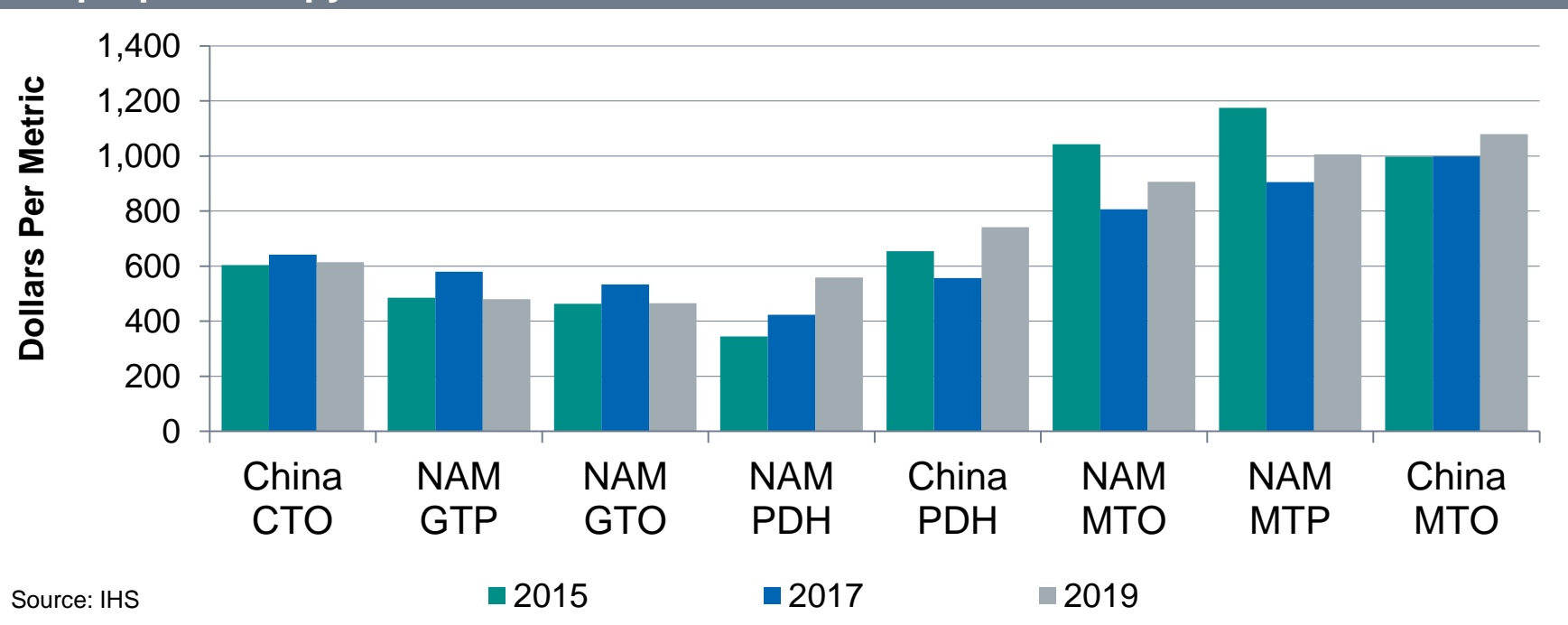


- **New Ethylene Capacity:** delayed start up timing of all “first wave” US ethylene units. Pushed out and/or removed MTO, CTO) in China
- **Build-cycle Disruption:** under investing new capacity during 2020-21 period; supporting margin “up-cycle” .
- **Effective Global Operating Rates:** expected high over the next 5 years assuming steady economic growth, current new-build profile, unplanned outages.
- **Naphtha crackers:** required to balance demand; increasing cash cost combined with need for naphtha cracking, push ethylene prices higher.

Propylene Cash Cost

Coal and Gas have cost advantage but high investment cost.

On-purpose Propylene Production Cash Costs



Source: IHS

Propylene Market

Key Issues



Propylene Requires On-Purpose Investment: margins for incremental supply will have to support new investments

On-Purpose Technology Will Vary: dependent on regional feedstock advantage - PDH in U.S., Middle East, and Asia along with coal to olefins in China; Chinese PDH units based on propane imports that compete into fuels market. MTP is high cost.

Build phase is delayed: investment in North American on-purpose propylene production delayed as questions over energy and the economy persist; "GTP under study".

Regional imbalance causes price volatility: overcapacity in propylene will cause major price shifts regionally but balance out over time. US monomer balance is long, derivatives are tighter.

Low prices stimulate demand: propylene demand growth is seeing strength due to ample low cost supplies.



IHS Markit™

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THANK YOU !!

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