Staying Competitive in a Feedstock Driven Market

Prepared for: NY Metro Section of AIChE

October 19, 2015

Agenda

- Nexant Overview
- Changes in the Global Petrochemical Landscape
- Global Industry Dynamics
  - Ethylene
  - Propylene
  - Butadiene
- Conclusions

Nexant Overview

Nexant is a global strategic, financial and technical advisory firm

Corporate Overview

- Founded in 2000 as a spinoff of Bechtel's Technology and Consulting Group; **ChemSystems established in 1964** and purchased by Nexant in 2001 from IBM
- Nexant provides **high value-added services** and products for the **global energy and chemicals industries**
- Over 700 employees globally
- Have completed over 3,000 client assignments in over 100 countries
- Principal investors include Telesoft Partners, Symphony Technology, Oak Investment Partners, Intel Capital, and The Beacon Group
- Organized into three business units

Business Divisions

Energy & Chemicals Advisory

- Business advisory services integrated across the entire energy value chain
- Technical, strategic, market, financial (new build, M&A, IPO) and project feasibility consulting services
- Advanced clean energy technology consulting services for development and commercialization
- Clients are oil, gas and chemical companies, financial companies, investors and governments

Energy Demand Management

- Design/management services for the largest U.S. energy efficiency incentive programs
- Demand-side management and carbon management services for end-users, government and energy services

Energy Software & Grid Management

- Advanced software for electric utilities, U.S. ISOs, grid operators, and energy market participants
- Automated systems for electric power grids
- Application service provider for energy market participants and energy producers

Nexant's Energy and Chemical Advisory team provides expertise across the energy value chain

Energy

POWER

- Electric Power
- Grid Management
- Distribution Software
- Energy Efficiency
- Demand Side Management

GAS

- Gas Market Analysis and Forecasts
- Gas Monetization
- Gas Regulation
- LNG & Pipeline Projects

DOWNSTREAM OIL

- Petroleum Refining
- Petroleum Logistics
- Product Market Forecasts
- Coal to liquids
- Gas to liquids

Chemicals and Clean-tech

CHEMICALS

- C_1 Chemicals and Fertilizers
- Olefins
- Aromatics
- Polymers
- Inorganics
- Specialty Chemicals
- Advanced Materials

GREEN CHEMICALS

- Syngas
- Biopolymers
- Olefins
- Alcohols
- Aromatics
- Sourced from Biomass, Algae, Wastes, and Agricultural Sources

RENEWABLE ENERGY

- Biomass
- Gasification
- Solar (Thermal & PV)
- Wind Power
- Clean Coal
- Capture and Sequestration
- Fuel Cells & Hydrogen
- Geothermal

Renewable/Traditional Product Interface

Leading global advisory to the energy and chemical industries with a proven track record

Global Footprint

- Nexant has offices in the major energy and chemical producing and consuming regions of the world
- Strong international presence allows us to provide valuable insights through our consultants' **local market knowledge** and our **vast network of sector specialists**

Our People

- **Over 150 consultants worldwide** in Energy and Chemical Advisory
- Our consultants blend strategic consulting, operational and technical expertise with **deep energy and chemical sector knowledge**
- Nexant's consultants are typically Chemical Engineers, Economists, and MBA Graduates who have **significant prior experience working at energy and chemical producers**

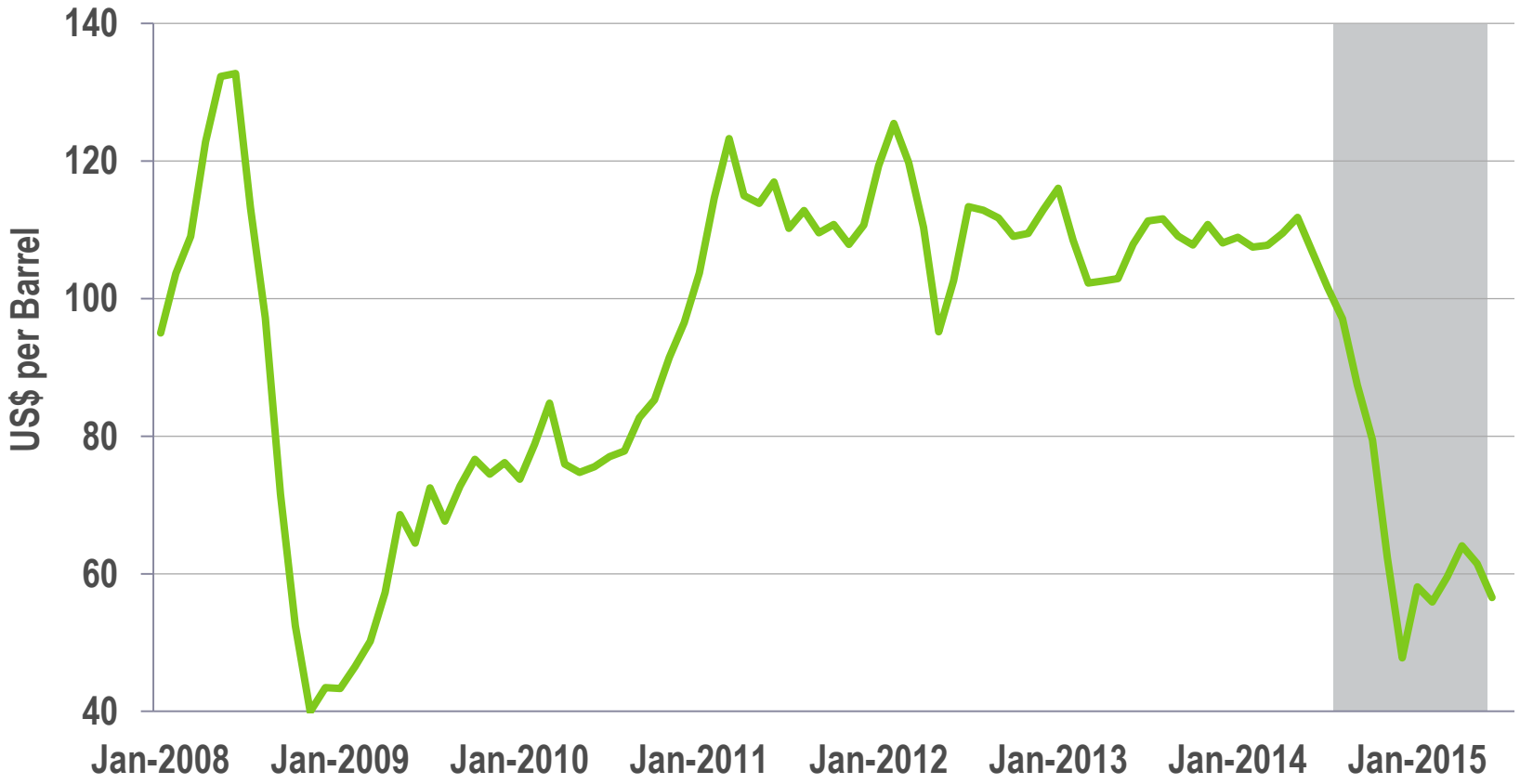
Proven Track Record

- Nexant has been advising clients in the energy and chemicals industries **for 50 years**
- We have completed **over 3,000 client assignments** including market assessments, technology evaluations, valuations/appraisals and due diligence

Changes in the Global Petrochemical Landscape

What a difference a year makes

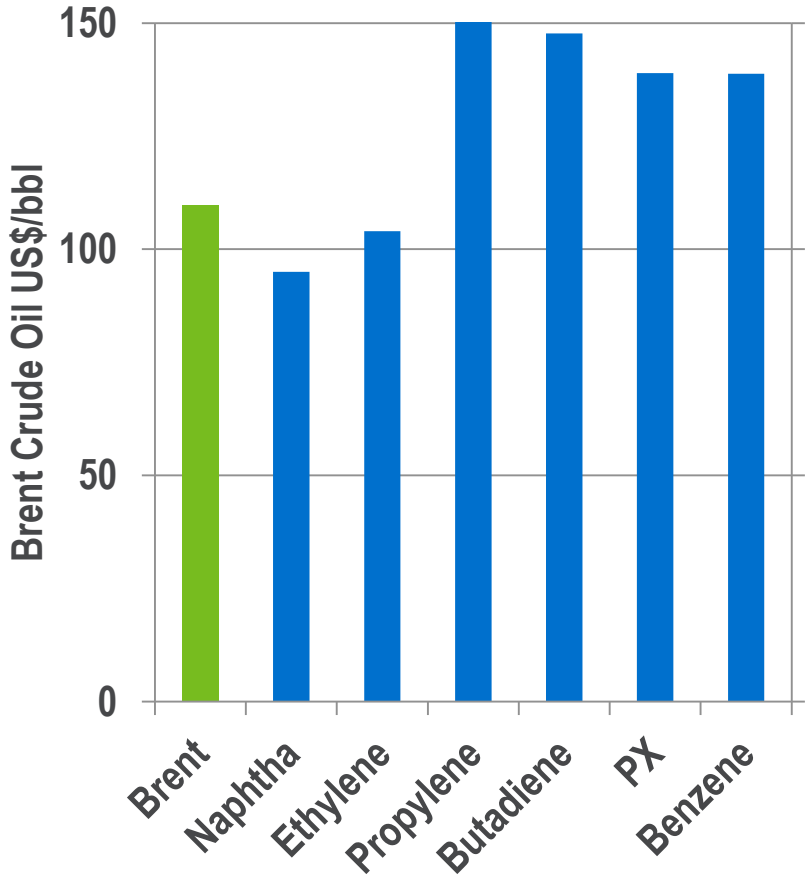
Brent Crude Oil Price Decline, monthly average



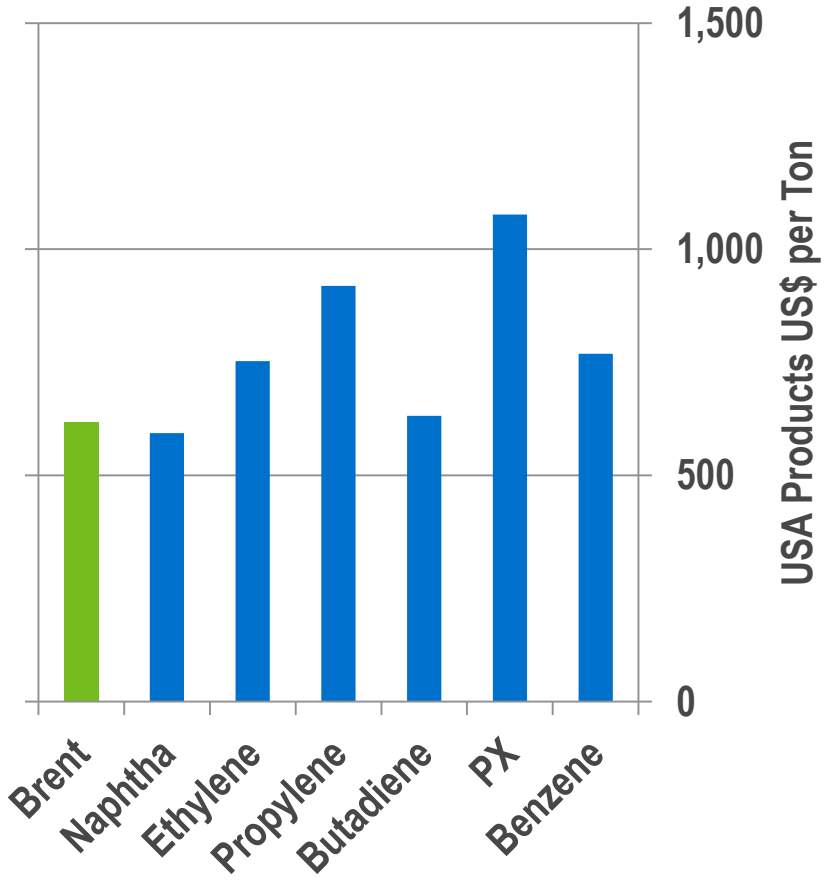
Source: Nexant

What a difference a year makes…..

Q2 2014



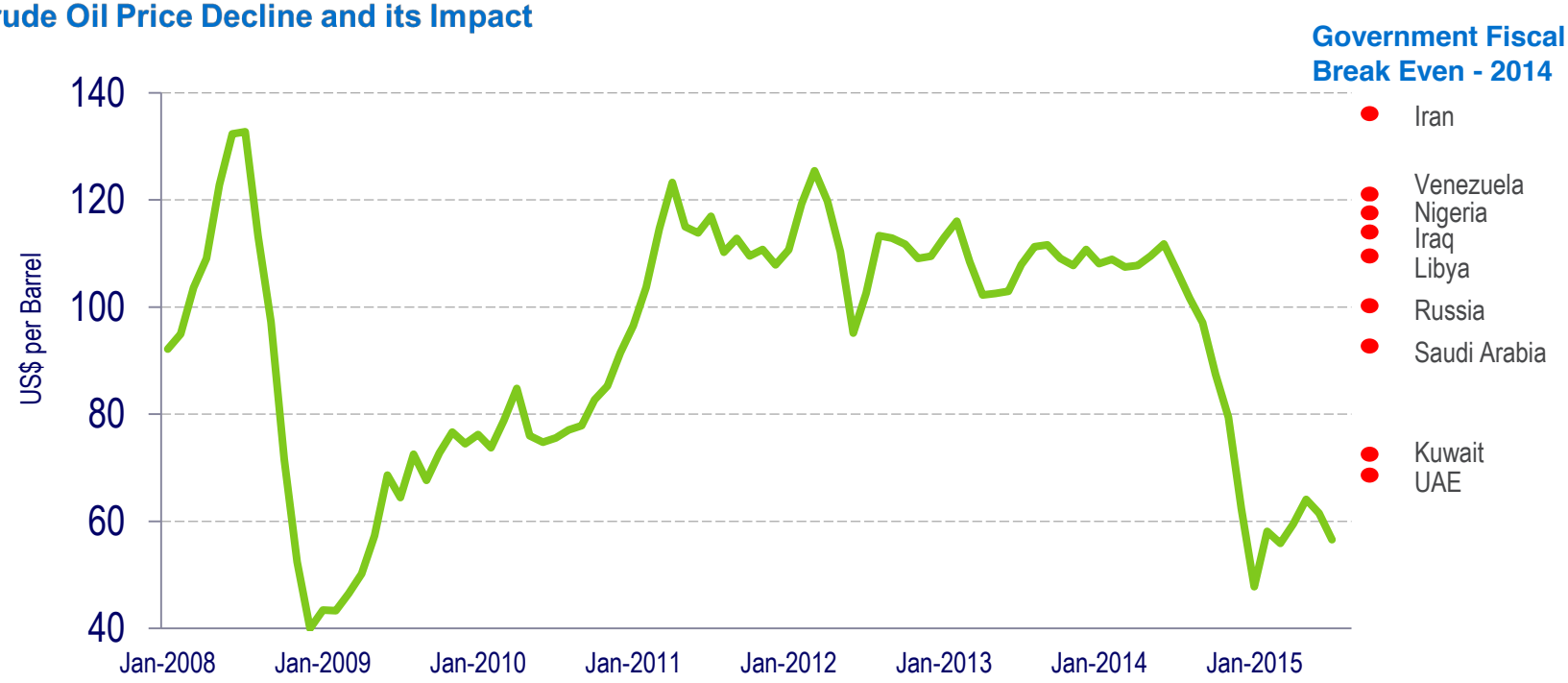
Q2 2015



The fall in oil prices has dramatically altered the investment landscape

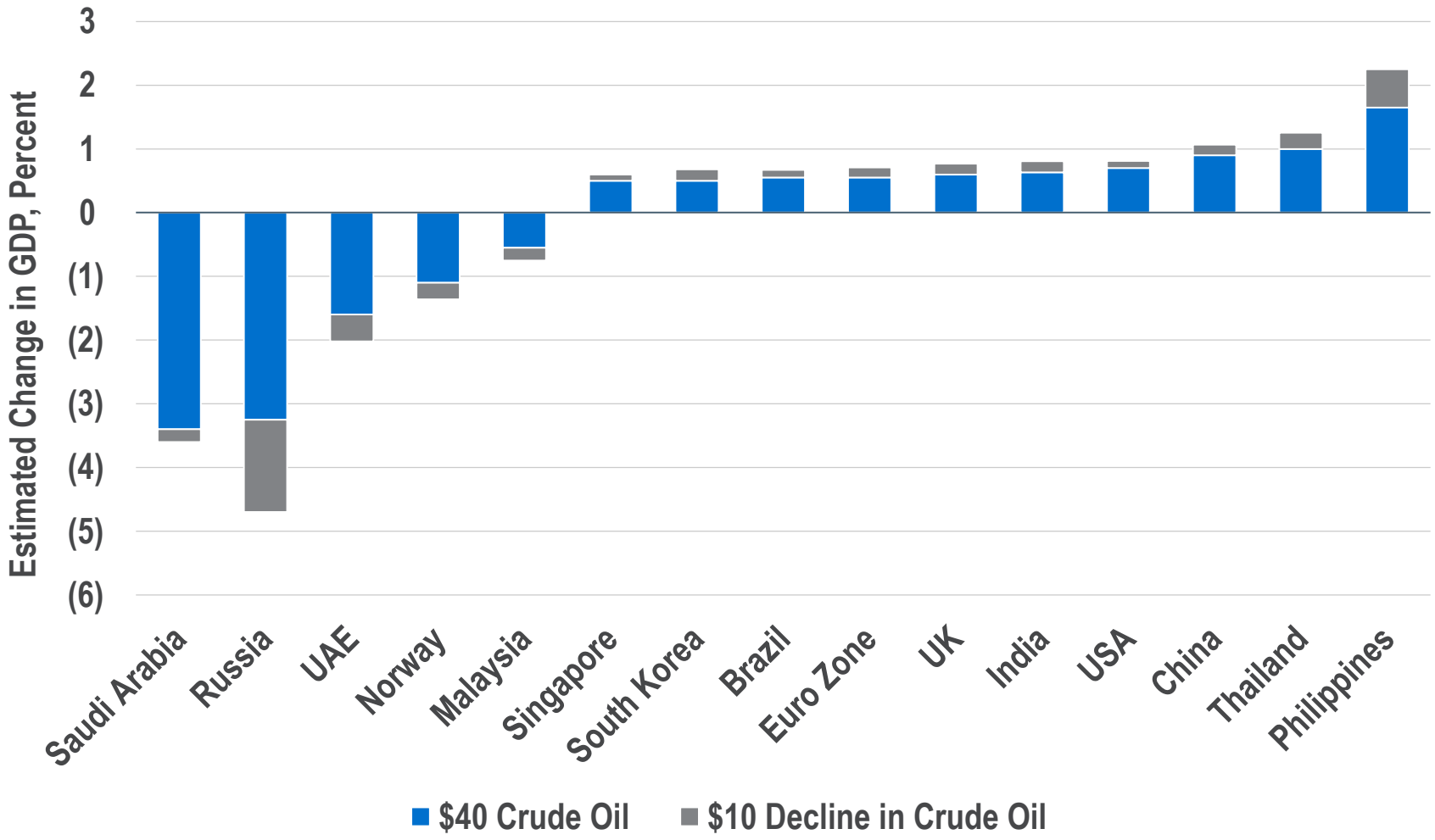
- Cancellation or delay of projects in major regions
- Decrease in planned ethane exports from the United States
- Reduced availability of investment funds by oil producing countries such as Venezuela
- Reduced emphasis on renewables into fuel, though significant emphasis on renewables into chemicals remain

Crude Oil Price Decline and its Impact



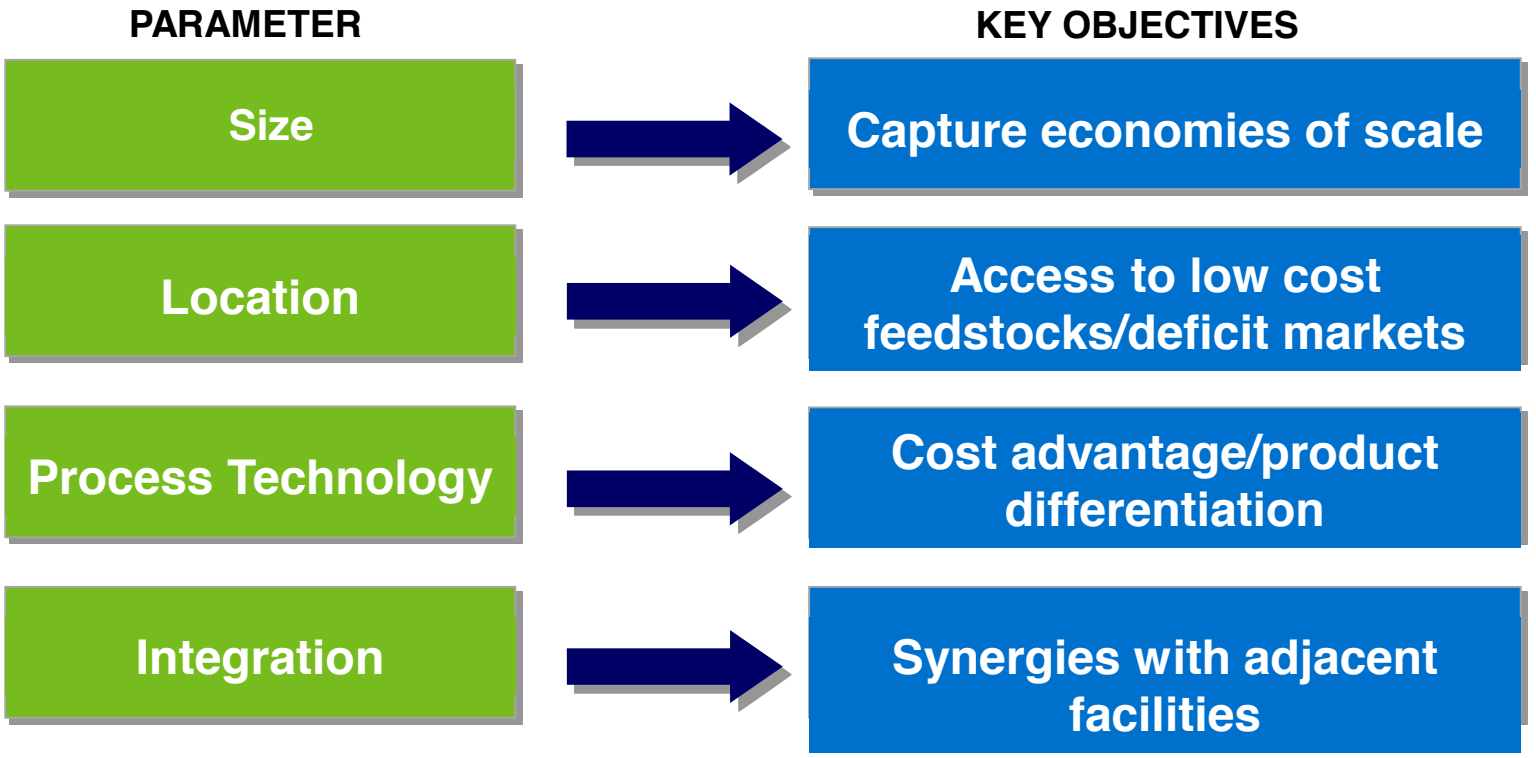
Source: Nexant/EIA

Impact of oil prices on economies results in winners and losers



Source: UBS/Oxford Economics

Uncertain times – but sources of competitive advantage remain clear and robust in refining and chemicals sectors



Global Ethylene Industry Dynamics

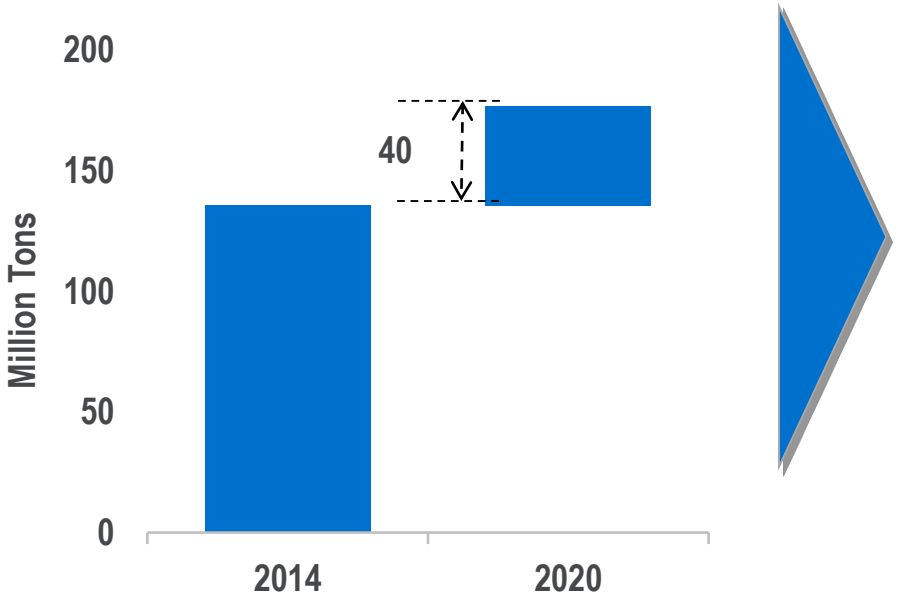
Regional petrochemicals trends – changing dynamics but familiar themes

- United States
- Lighter feedstocks
- Export markets
- Capital costs
- Product differentiation

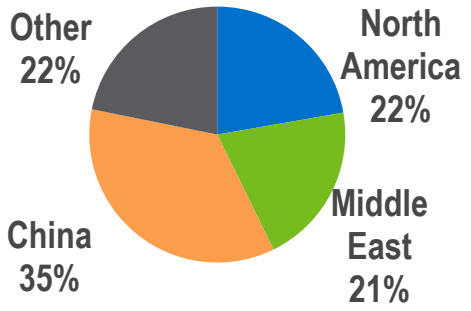
- Middle East
- Heavier feedstocks
- Export markets
- Integration
- Product differentiation

- China
- Diversified feedstocks
- Economic growth
- Environmental issues
- Product differentiation

Ethylene Capacity Drivers

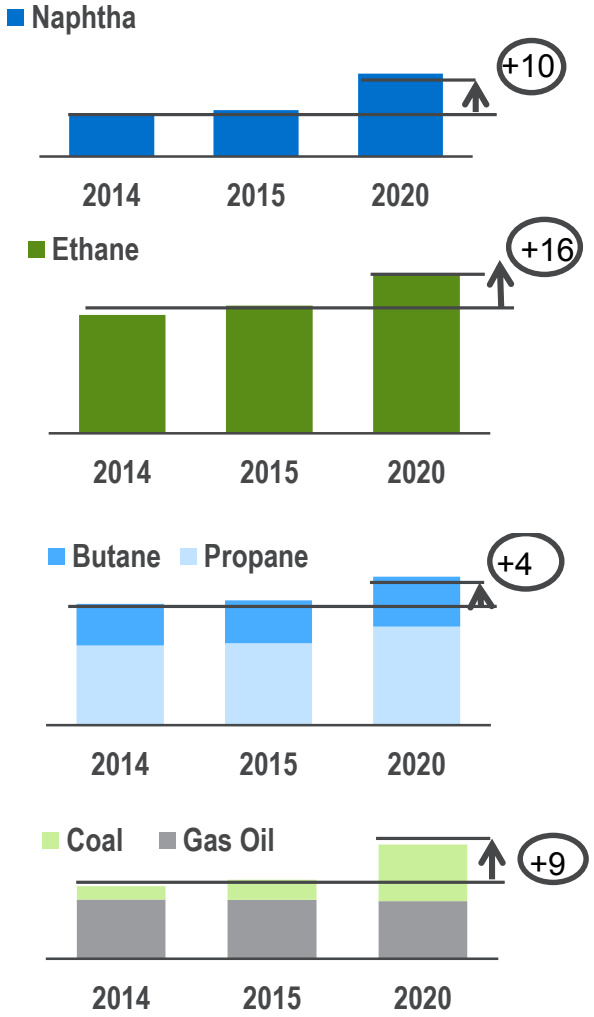


Ethylene Capacity Additions by Region

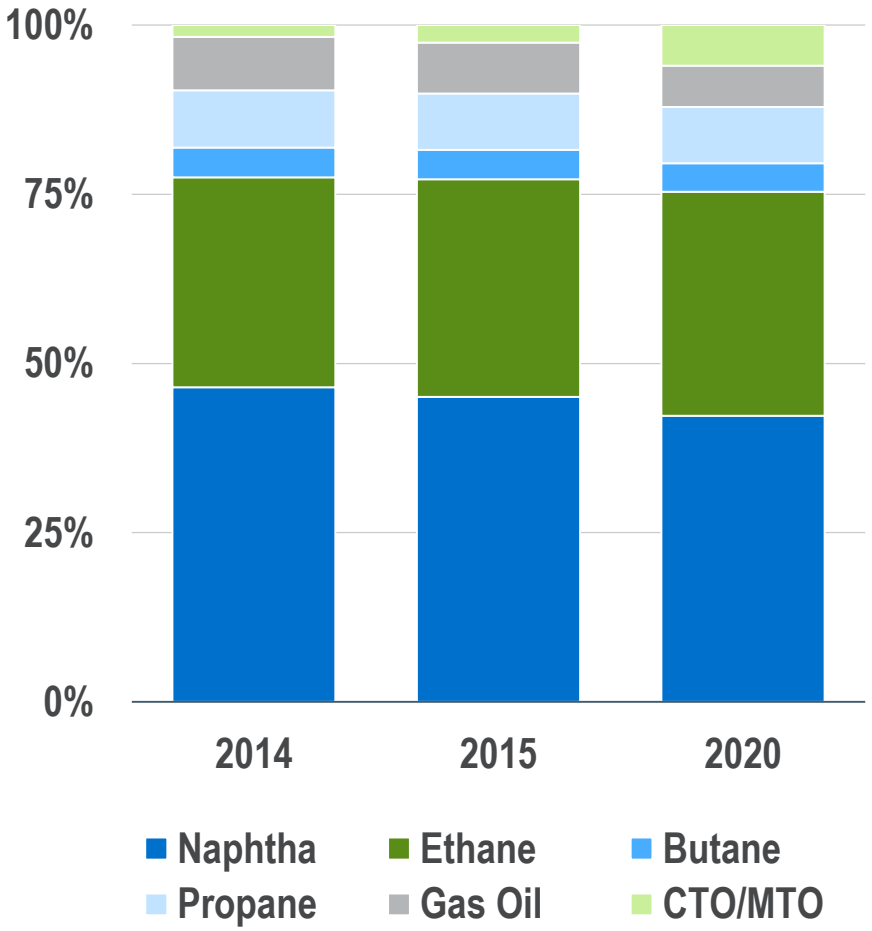


Naphtha share is forecast to decline as a result of increase light feedstock consumption in U.S., Europe, and M. East and CTO/MTO in China

Millions tons per year of ethylene

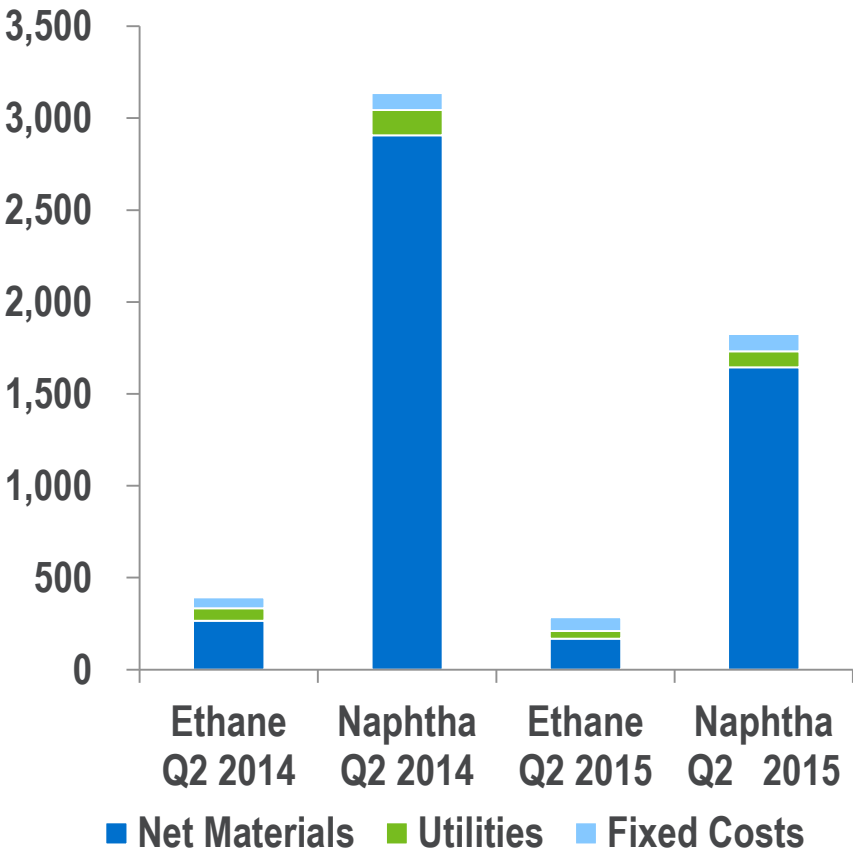


Global Ethylene Capacity by Feedstock

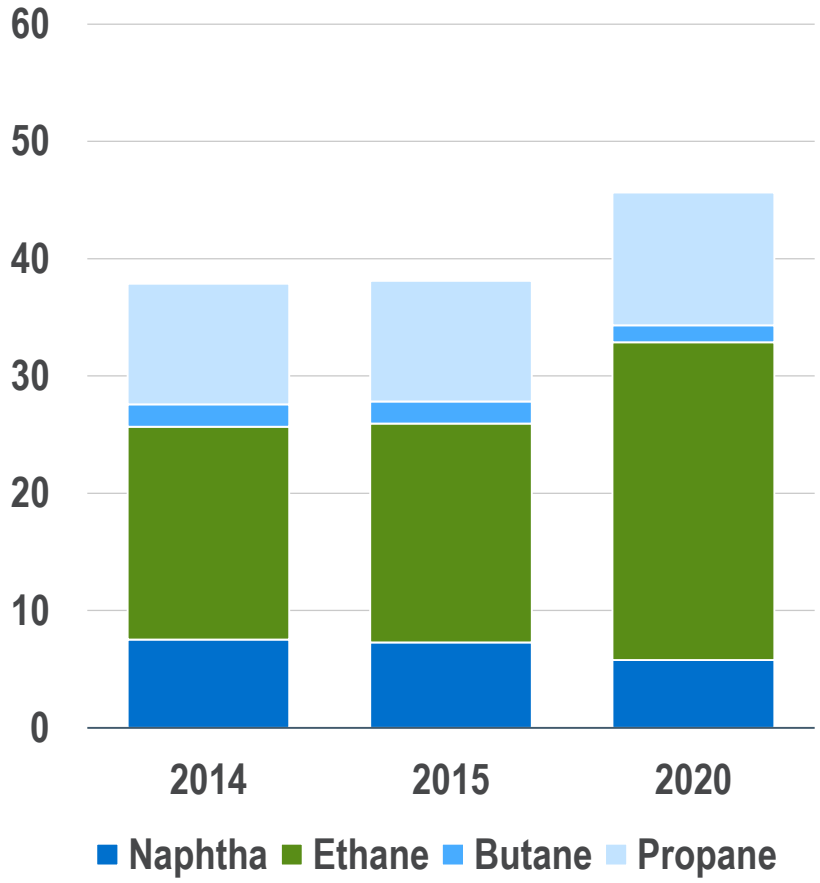


Oil prices have had a radical effect on feedstock prices since late 2014, but the effects on competitiveness are less well defined

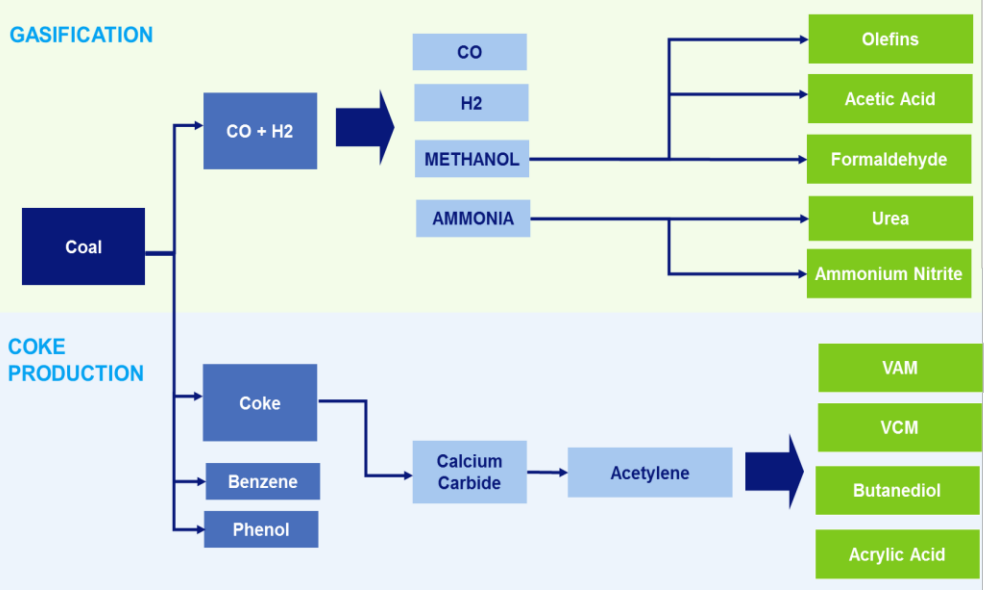
U.S. Ethylene Costs (U.S.$ per ton)



U.S. Ethylene Feedstock Consumption (Million tons)



Over 50 Coal based projects focused in China



Phase 1: Coke Based

- Acetylene based VCM
- Benzene

Phase 2: Syngas

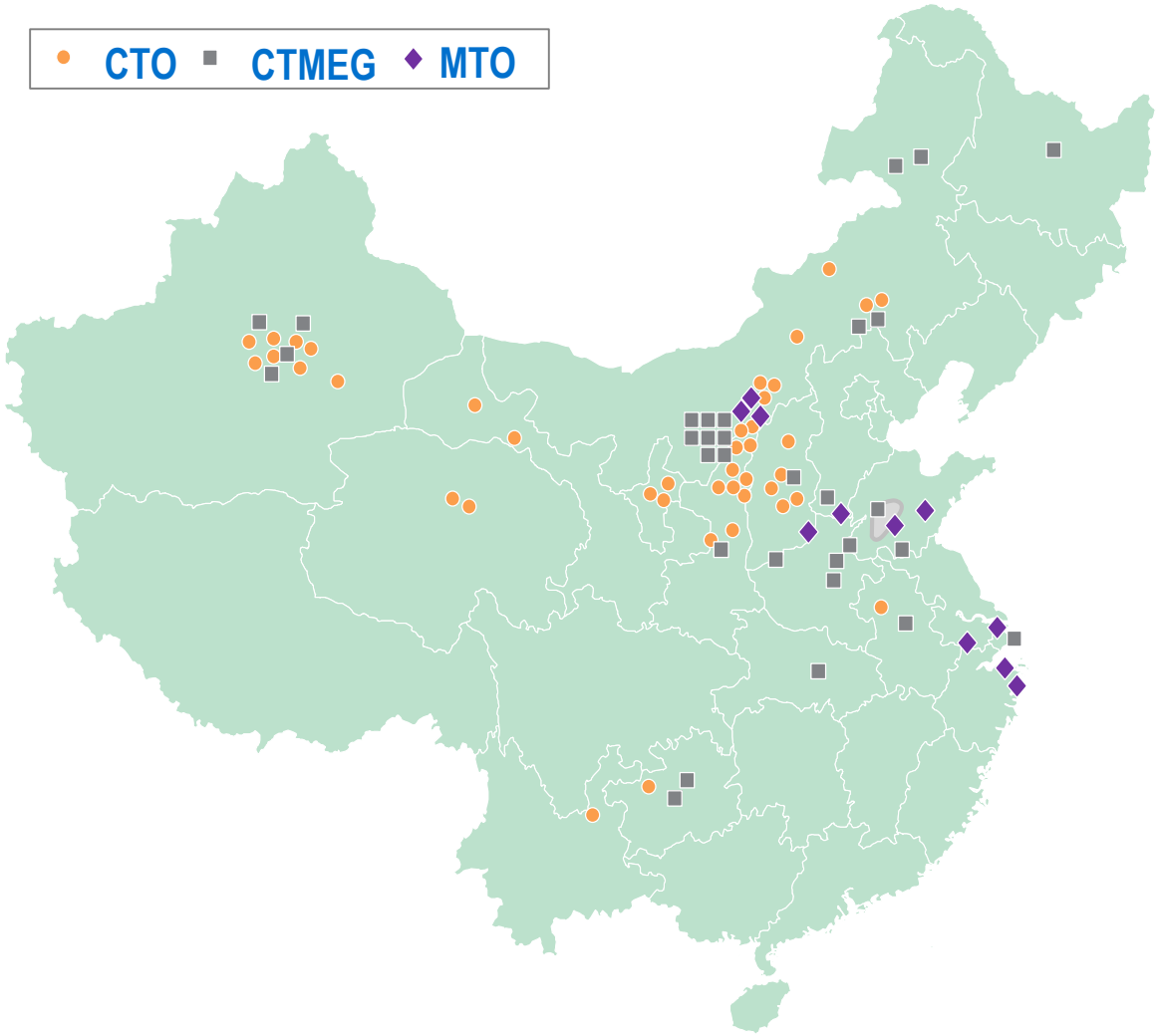
- Methanol/Ammonia
- MTO/MTP

Phase 3: New Technology

- MEG via DMO
- Acetyl to ethanol
- Methanol to PX

Nexant

Many projects in implementation phase but facing increasing challenges



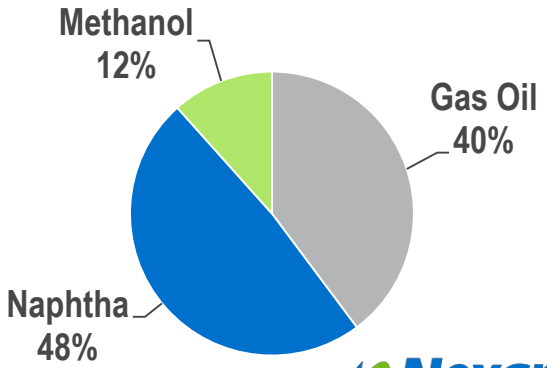
Major Development Trends

- Opportunity to valorize "stranded coal".
- Coastal projects importing methanol

Sector Challenges

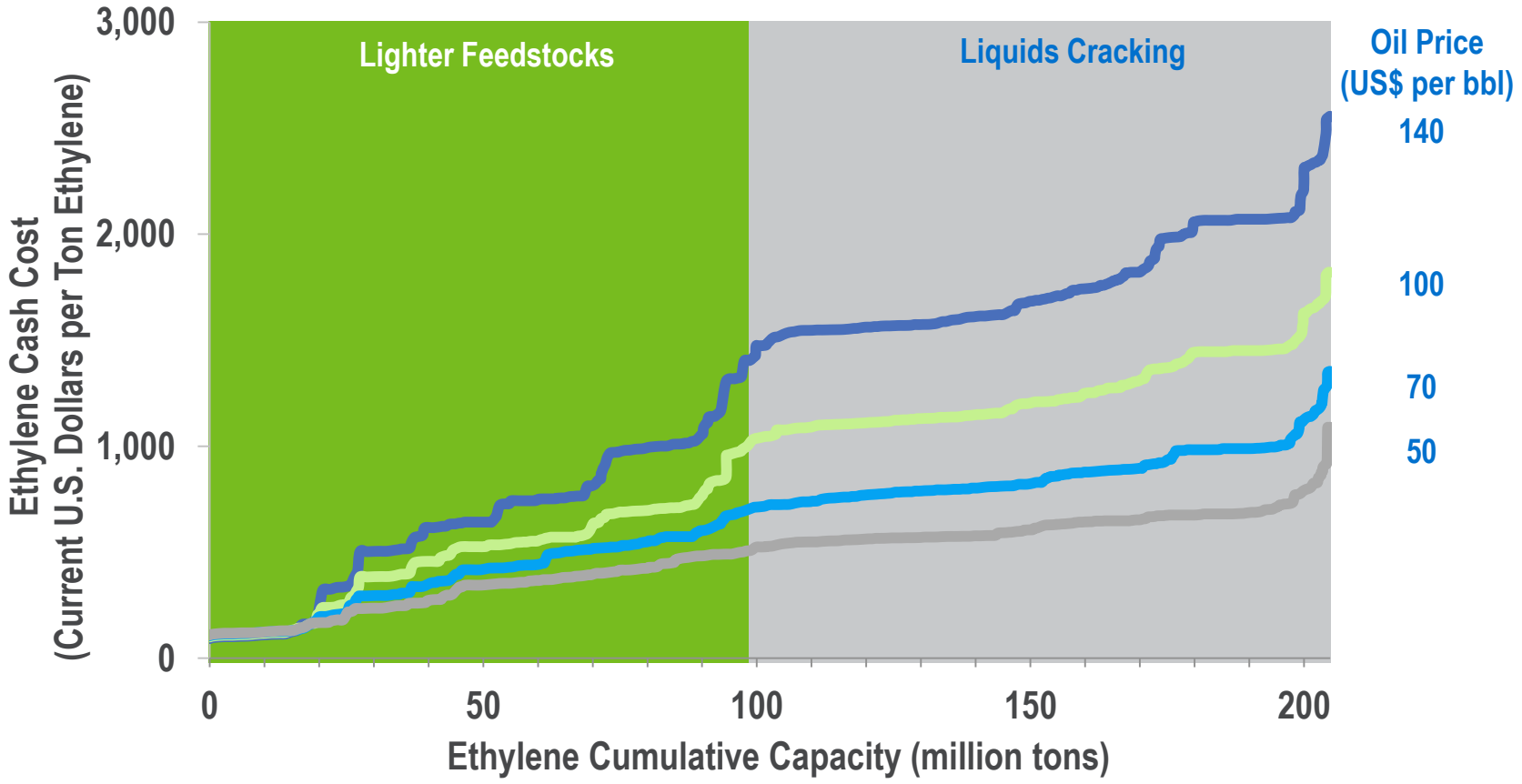
- Environmental issues
- Capital cost
- Production cost competitiveness

China Ethylene Feedstock Consumption – 2015



Petrochemicals feedstock cost advantages remain at lower oil prices but are substantially reduced

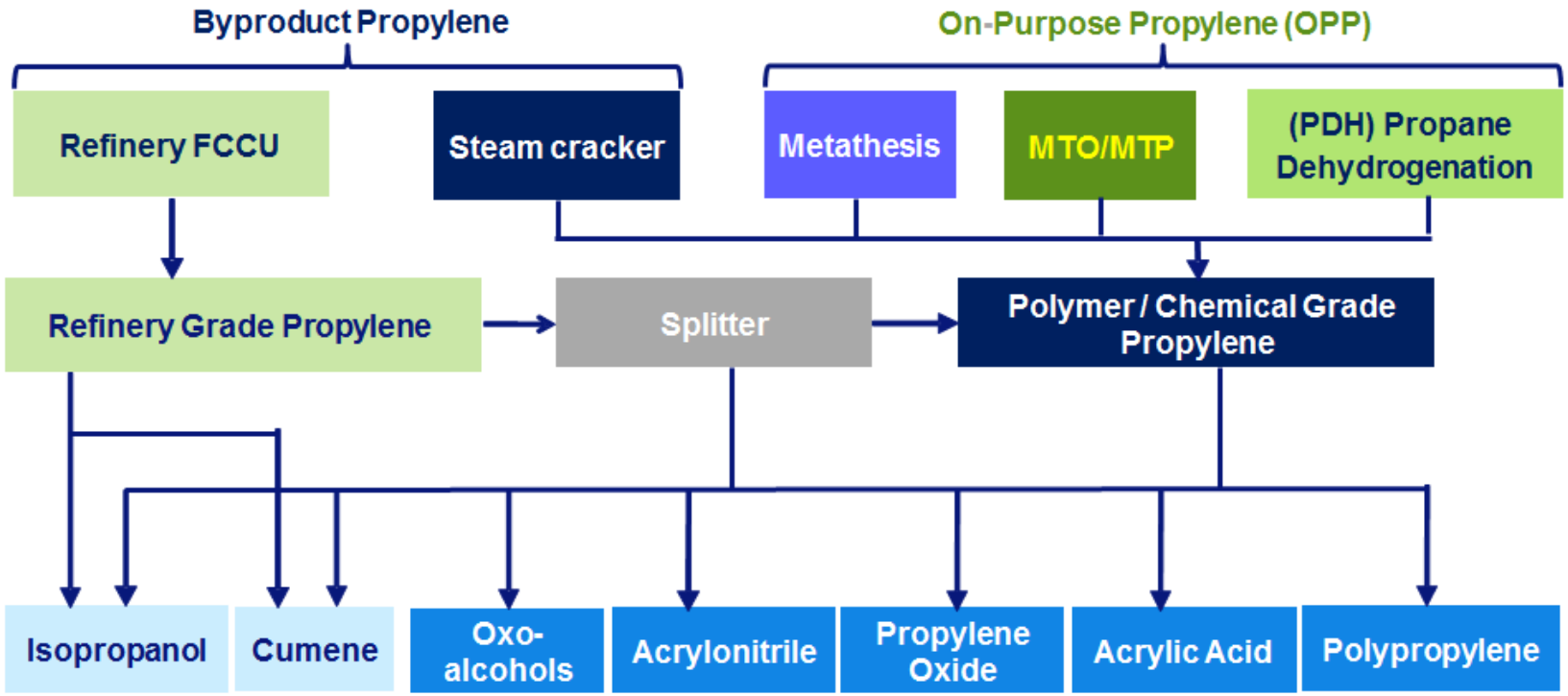
Global Ethylene Production Cost Curves versus Brent Crude Oil Price



The cost curve is much steeper with higher oil prices

Global Propylene Industry Dynamics

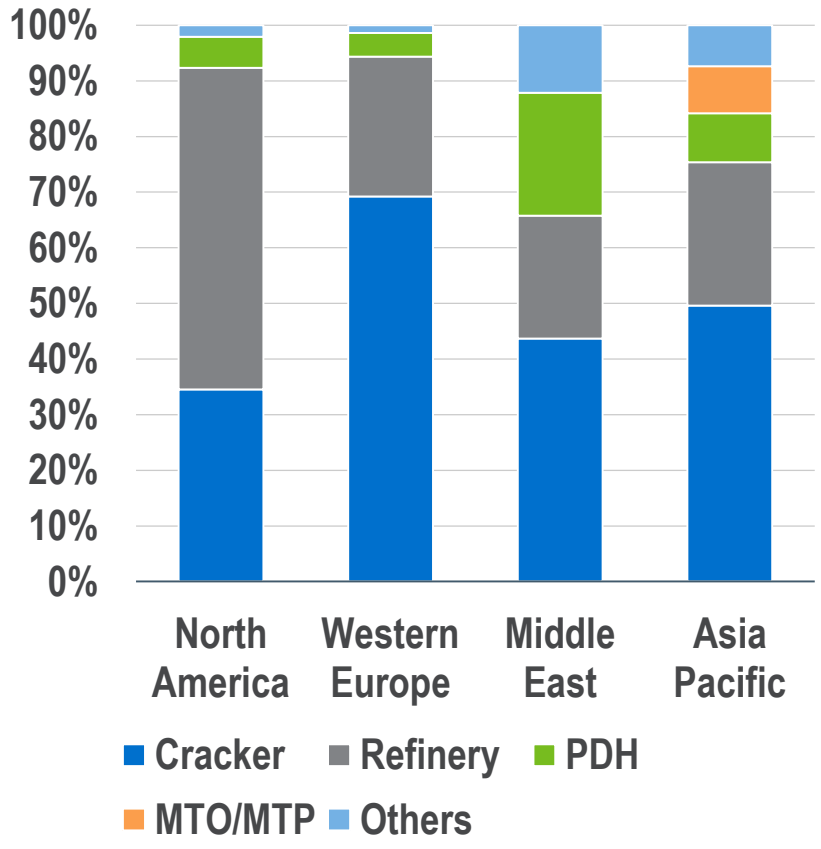
There are three primary routes to on-purpose propylene



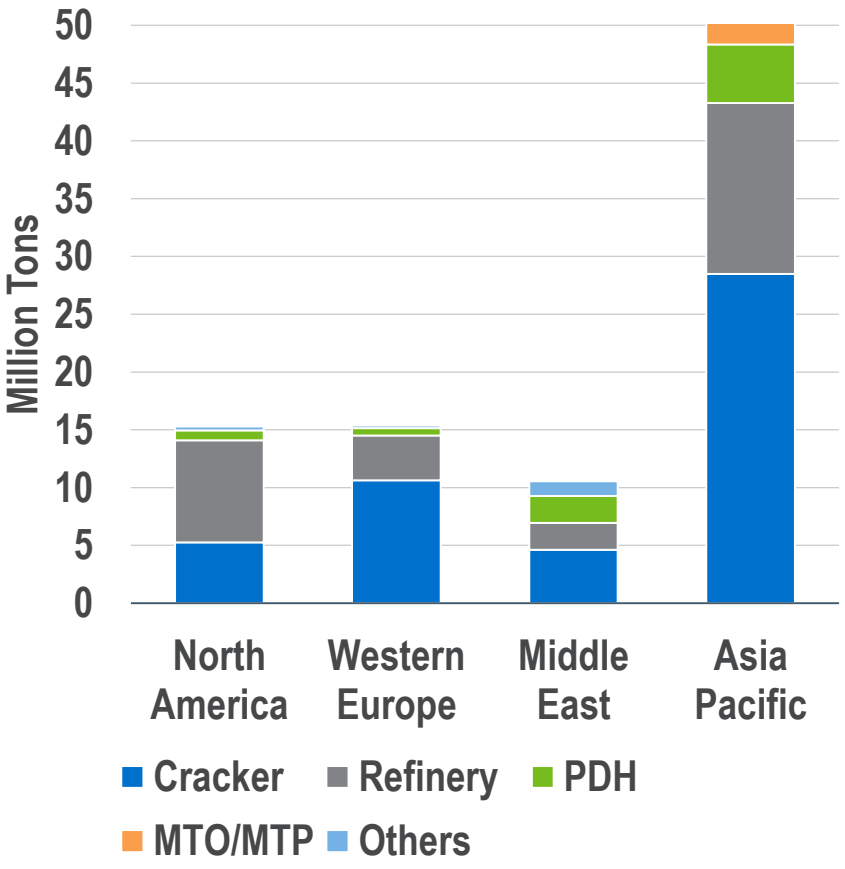
…metathesis of ethylene feedstock from ethane, methanol conversion from coal or natural gas, and PDH from propane

Steam cracking and refinery FCCs currently account for a majority of propylene supply. On-purpose production is still relatively modest

Global Propylene Capacity by Feedstock (2015)

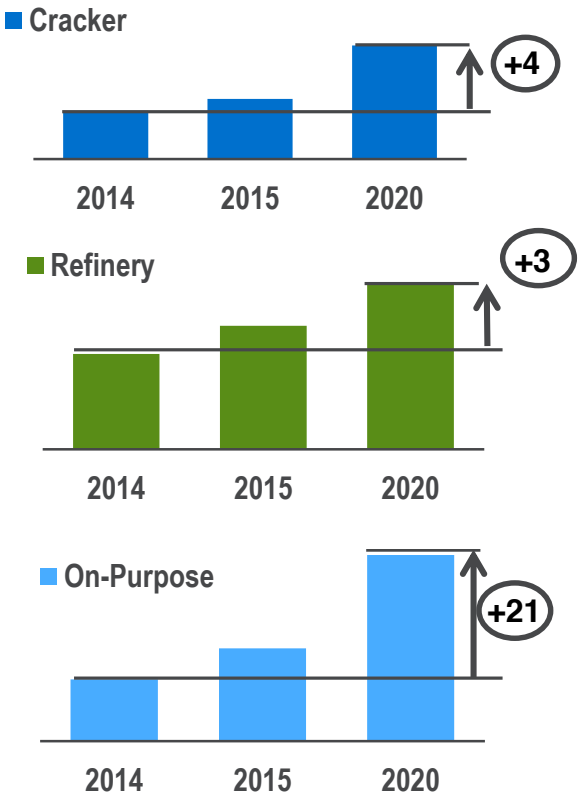


Global Propylene Capacity by Feedstock (Volume Basis, 2015)

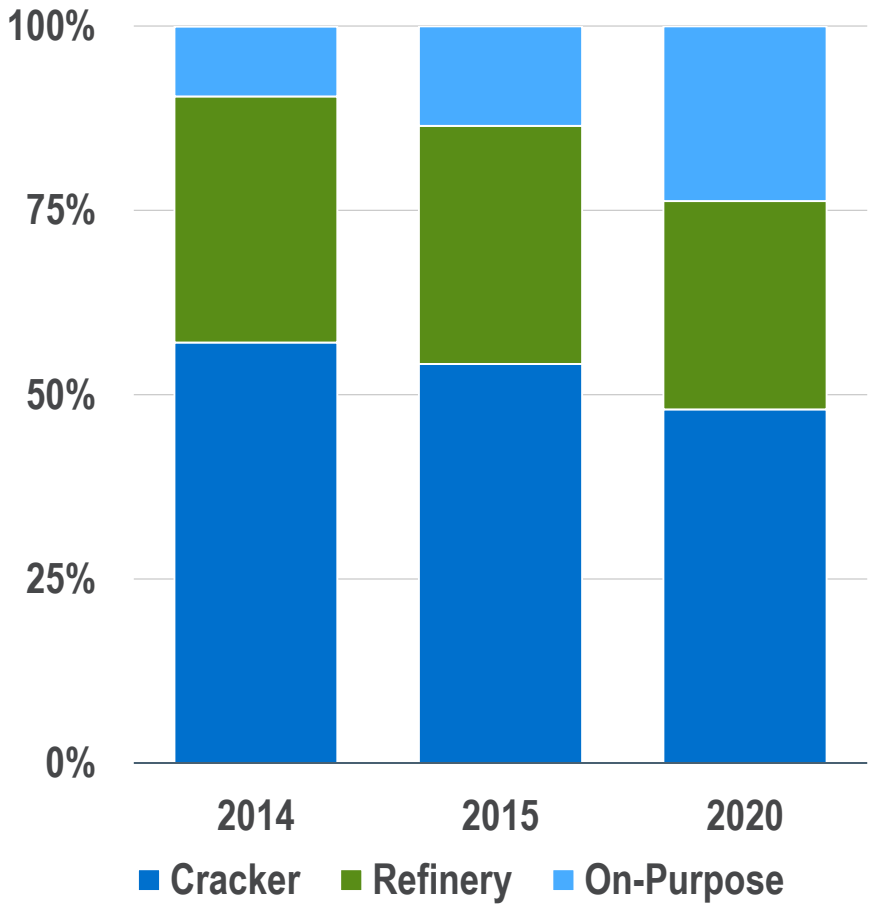


Going forward, a greater need for on-purpose production capacity is emerging to meet future propylene demand requirements

Millions Tons per Year of Propylene

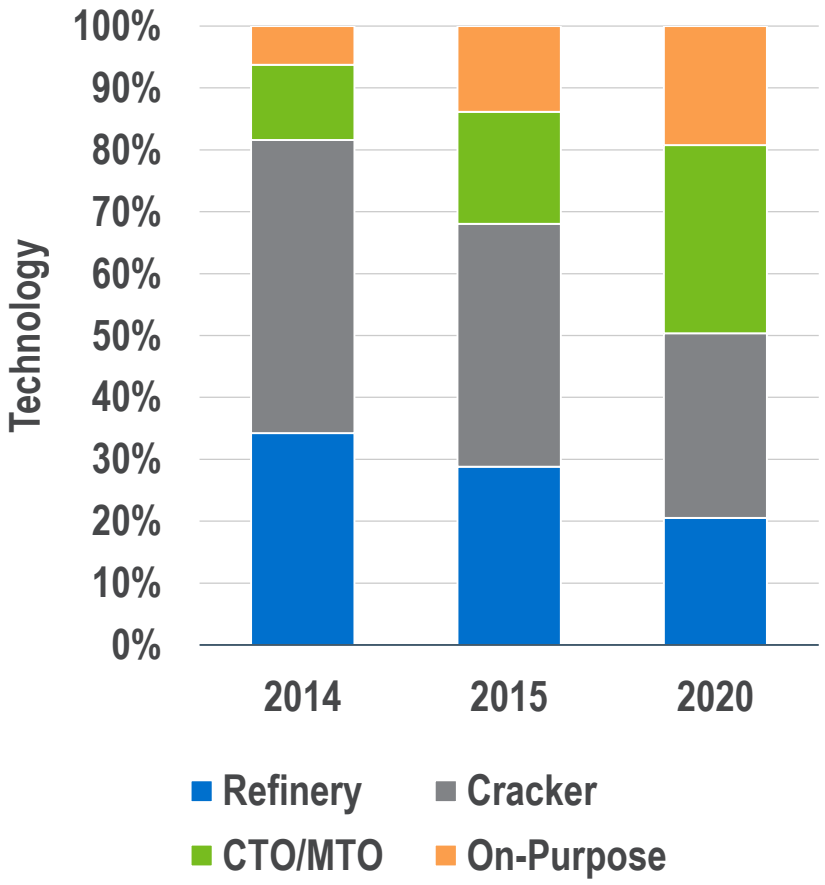


Global Propylene Capacity by Feedstock

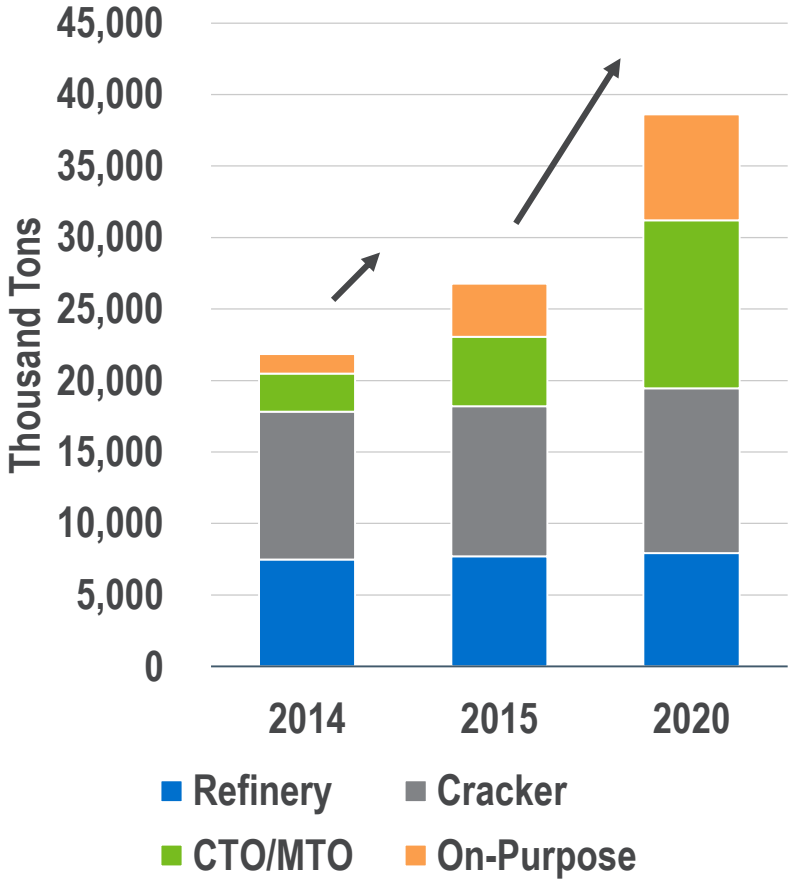


China's propylene expansion driving non-conventional technology routes

China Propylene Capacity by Feedstock

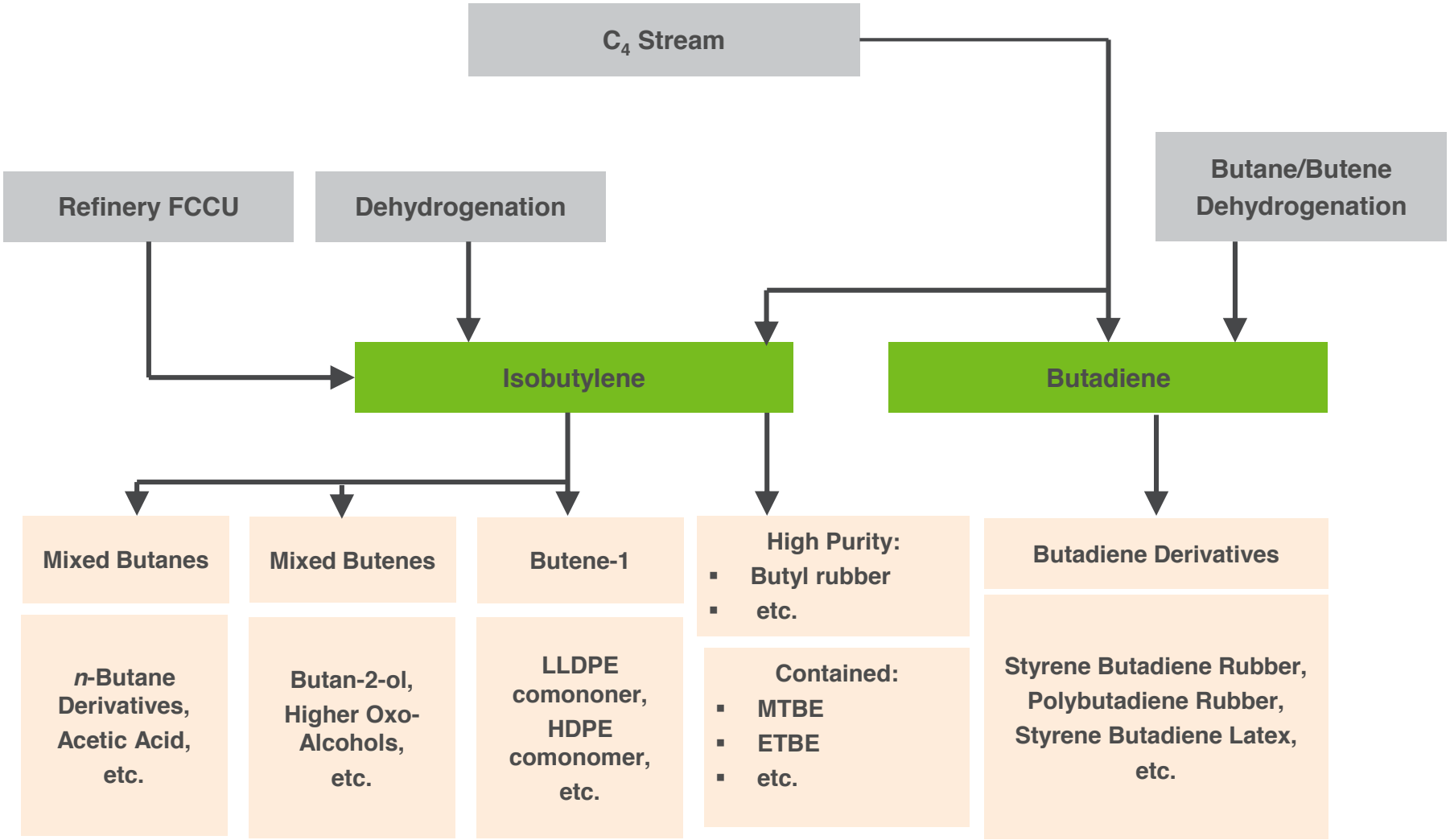


China Propylene Capacity



Global Butadiene Industry Dynamics

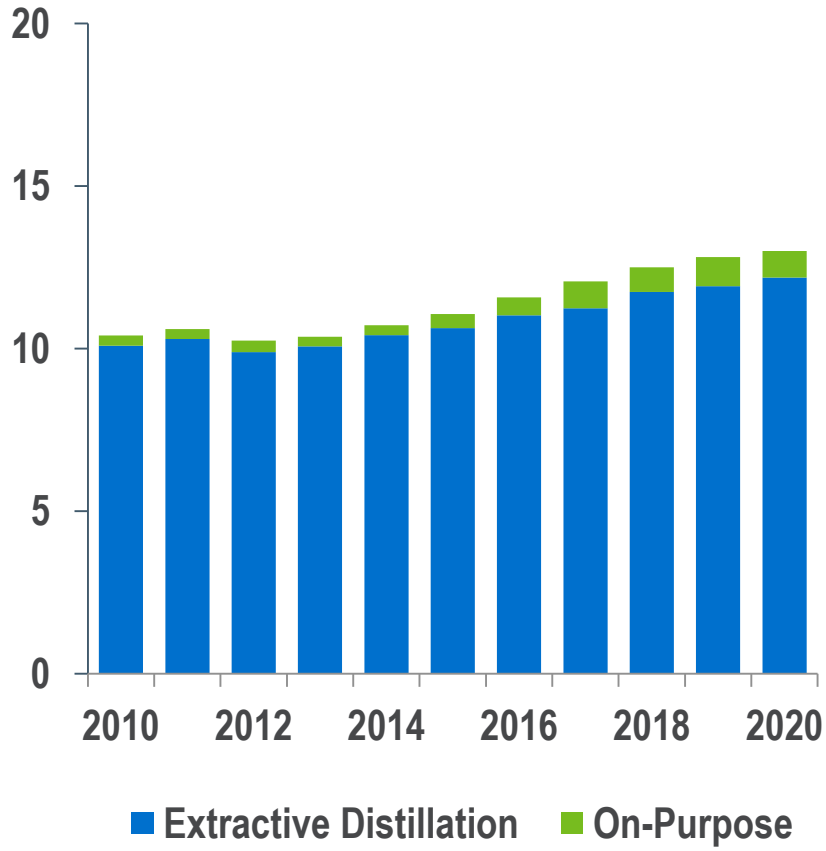
Butane/butene dehydrogenation is an alternative route for butadiene production



There is increased investment in alternative sources, with a step change in 2012-2014

Global Butadiene Production by Process

(Million tons)

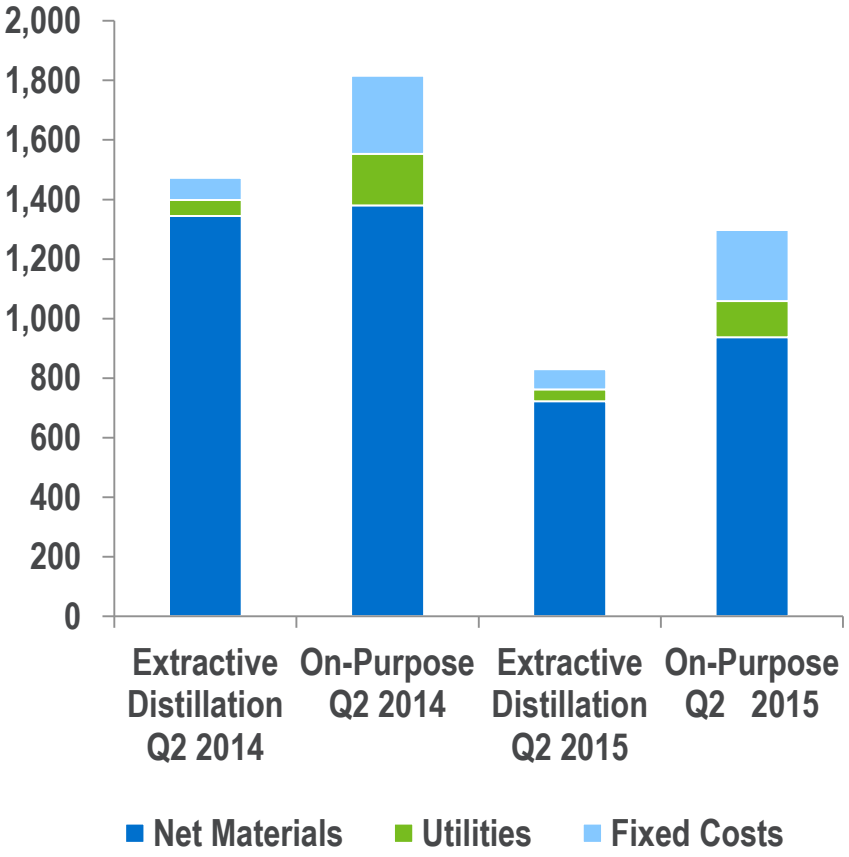


- Global butadiene production in 2014 was 10.7 million tons where approximately 3 percent of butadiene was produced from dehydrogenation
- Chinese companies reacted quickly to the peak pricing in 2011-2012 and are implementing numerous butene dehydrogenation projects using new (and proven) Chinese technology
- By 2020, more than 6 percent of butadiene will be produced from dehydrogenation globally

Feedstock costs main driver of butadiene economics

U.S. Butadiene Costs

(U.S.$ per ton)



- Historically, extractive distillation has been the low cost route to butadiene
- As the market requires on-purpose butadiene (OPBD), new sources of marginally cost effective butadiene supply (i.e., bio-based butadiene) are being explored

Conclusions

In summary…

- The fall in oil prices has dramatically altered the investment landscape
- In order to ensure competitive feedstock positions, major regions are changing to alternative feedstocks
- Lower oil prices have narrowed the gap between high and low cost olefins producers, but Middle East and U.S. NGL-based producers remain the most competitive
- The United States has moved toward light feedstocks due to their cost advantages
- The Middle East is focusing on integration with refineries to obtain sources of competitive advantage and capture them through the value chain
- Coalfield methanol-to-olefins (MTO) in China remains highly competitive, although MTO plants based on purchased methanol face a more challenging situation

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