

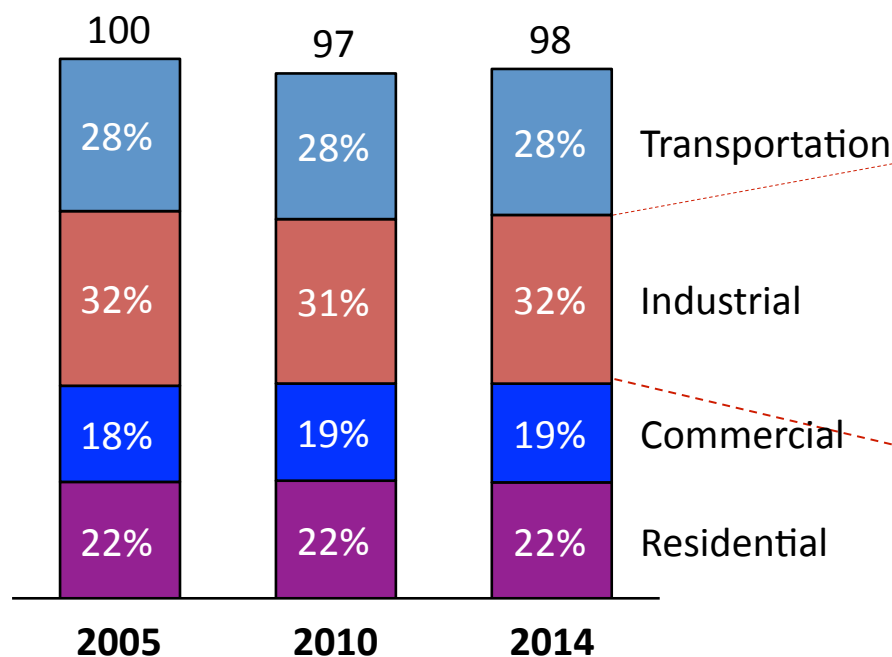
Hydrocarbon gas liquids: Developments in petrochemicals

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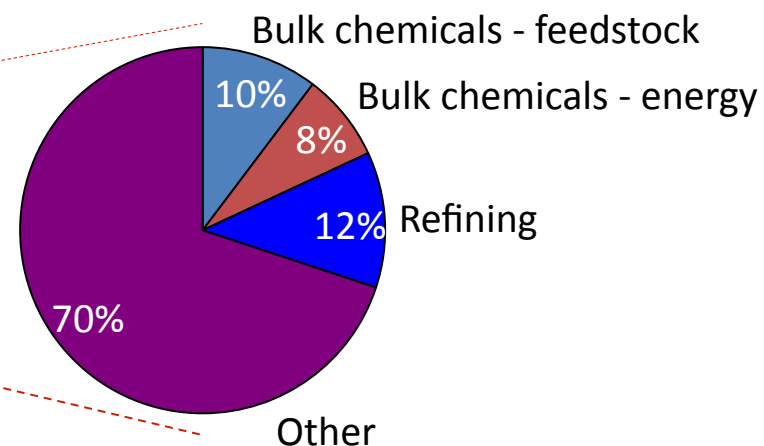
Braskem

Chemicals is the largest U.S. industrial consumer of energy resources

Total U.S. energy consumption¹
Quadrillion BTU



Breakdown of 2014 US industrial energy consumption
%



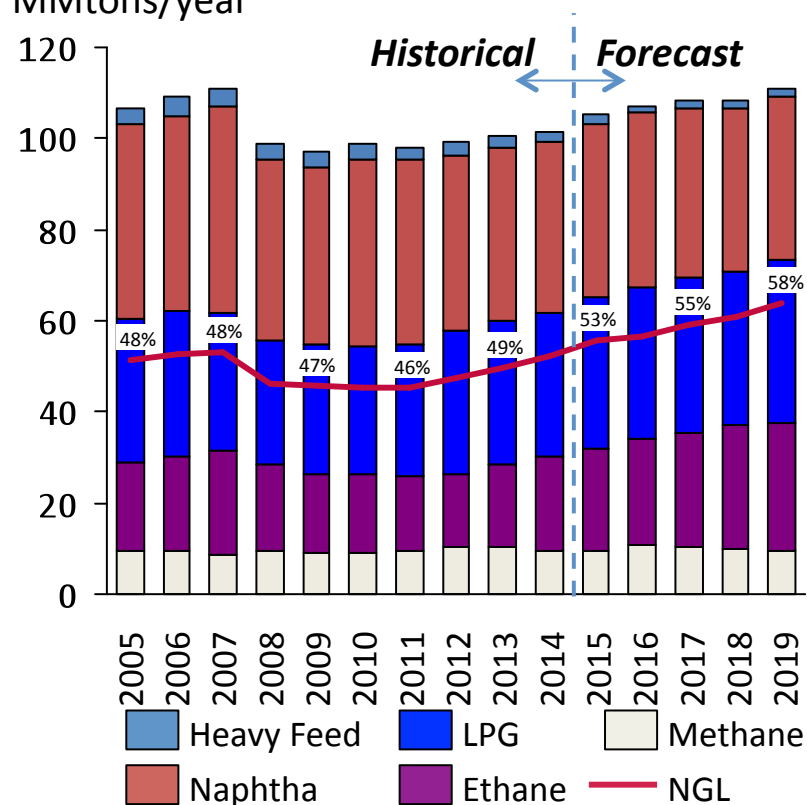
1. Includes coal, natural gas, petroleum, hydrothermal,
Source: EIA data 2014, AEO 2015

NGLs became the dominant petrochemical feedstock...

U.S. petrochemicals feedstock

Feedstock quantity

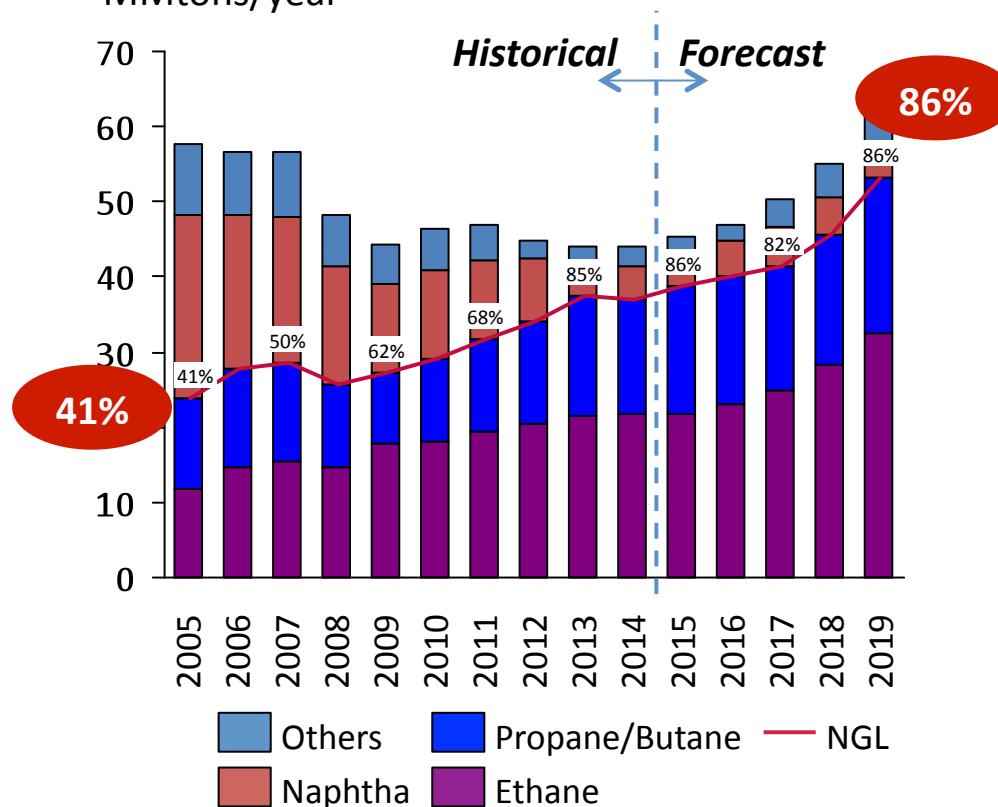
MMtons/year



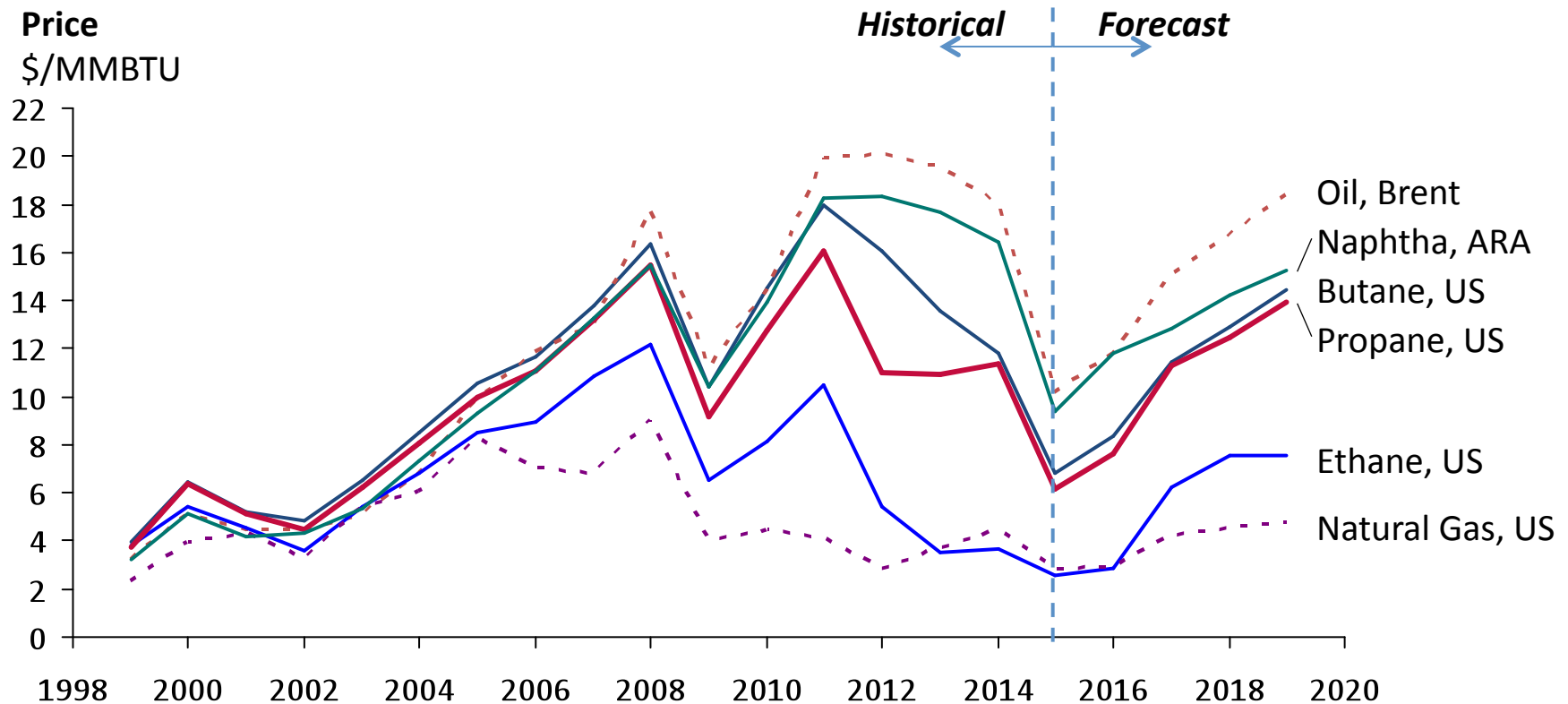
North American olefins feedstock

Feedstock quantity

MMtons/year



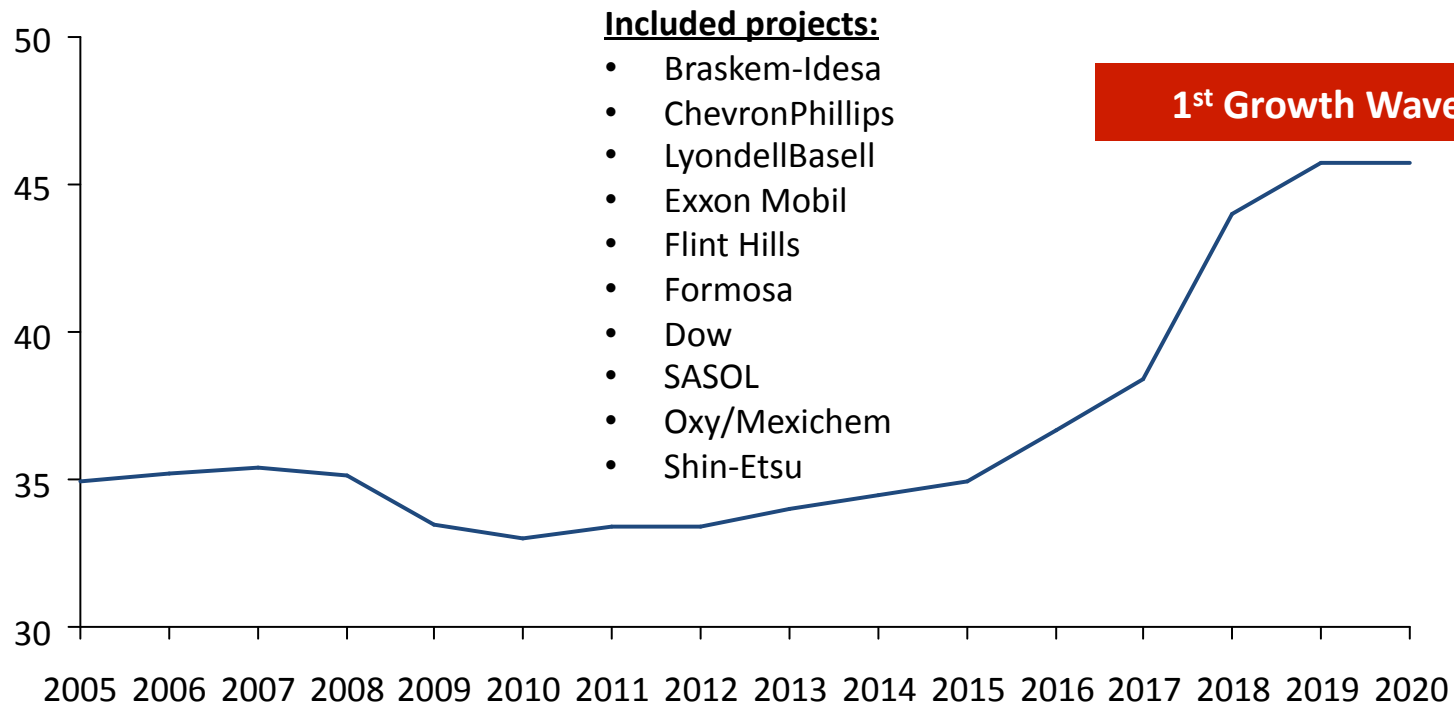
... due to its competitive advantage over oil, naphtha



Source: IHS energy price forecasts

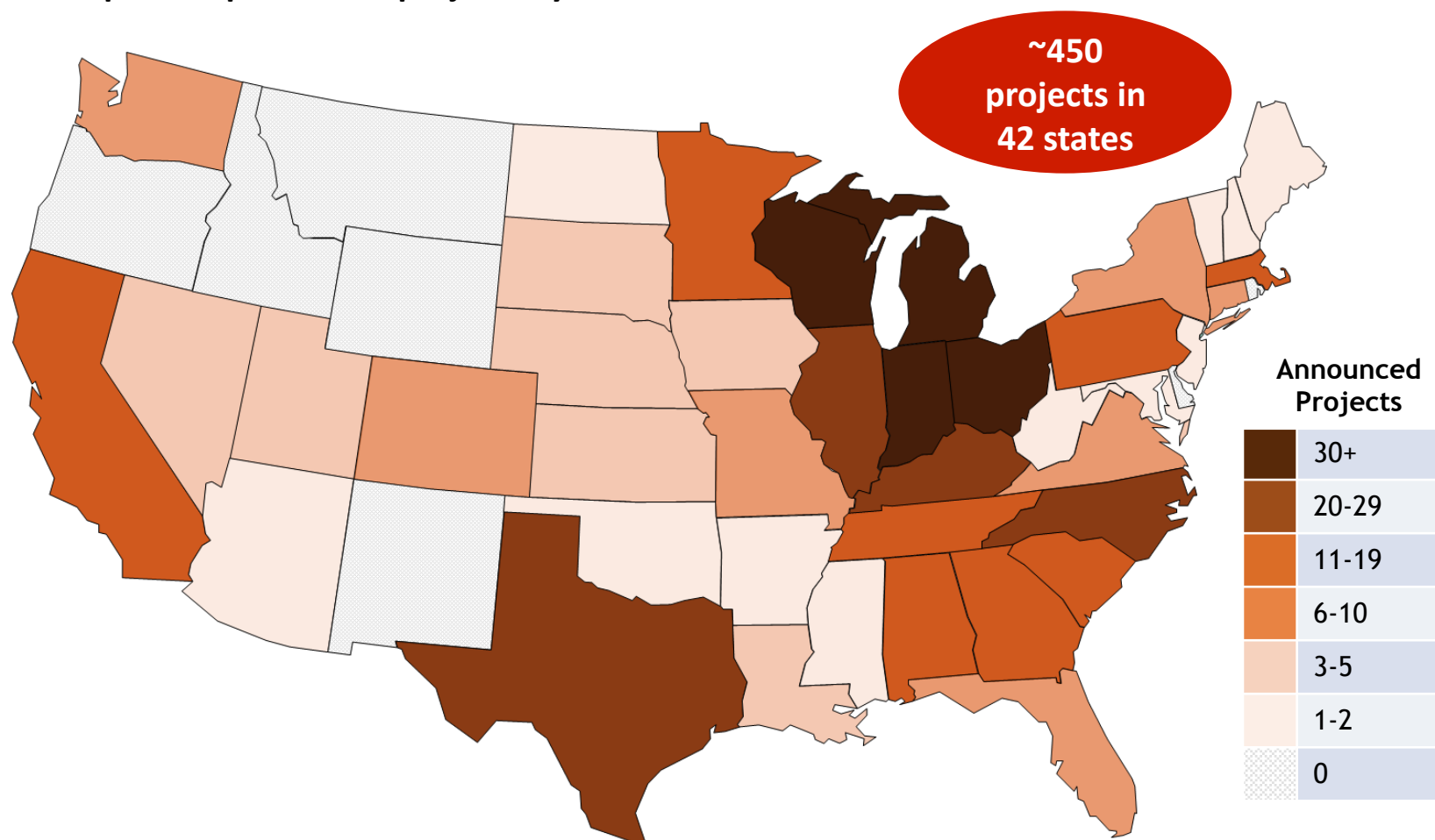
This has led to an ethylene capacity growth wave...

North American ethylene capacity
MMtons



...followed by investments in plastic conversion

Announced plastics processors projects by state, Jun 2012 – Feb 2015

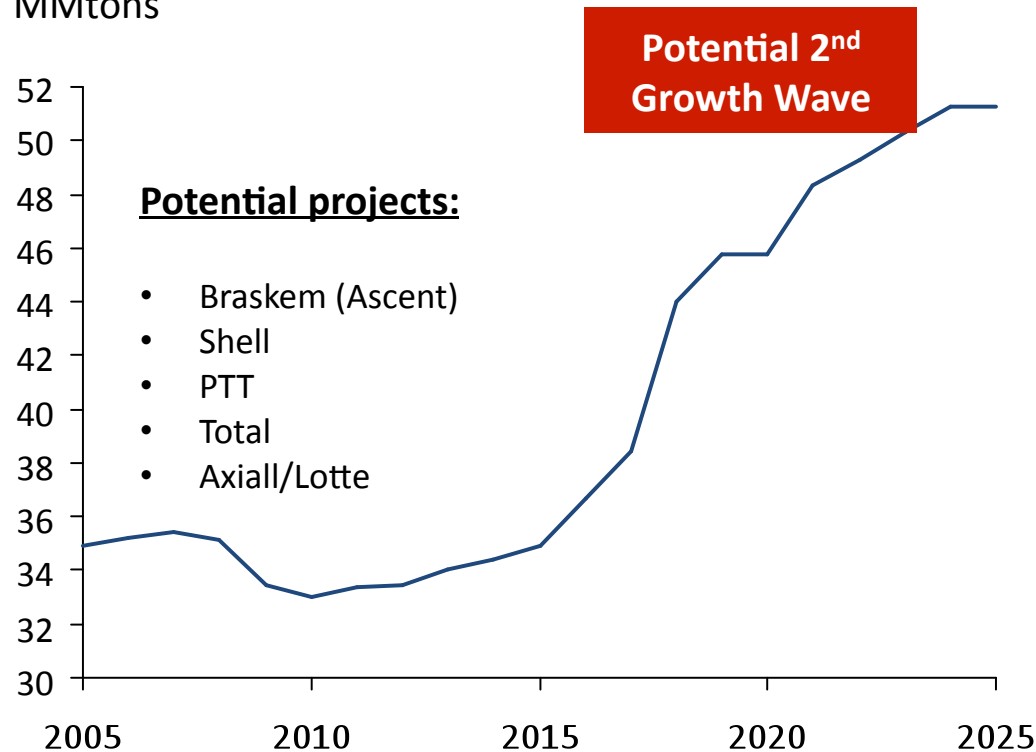


NOTE: 1 project has been announced in AK; none in HI (not shown)

Source: Plastics News, ACC

Feedstock advantage is not enough to justify a 2nd wave

North American ethylene capacity
MMtons



Critical challenges

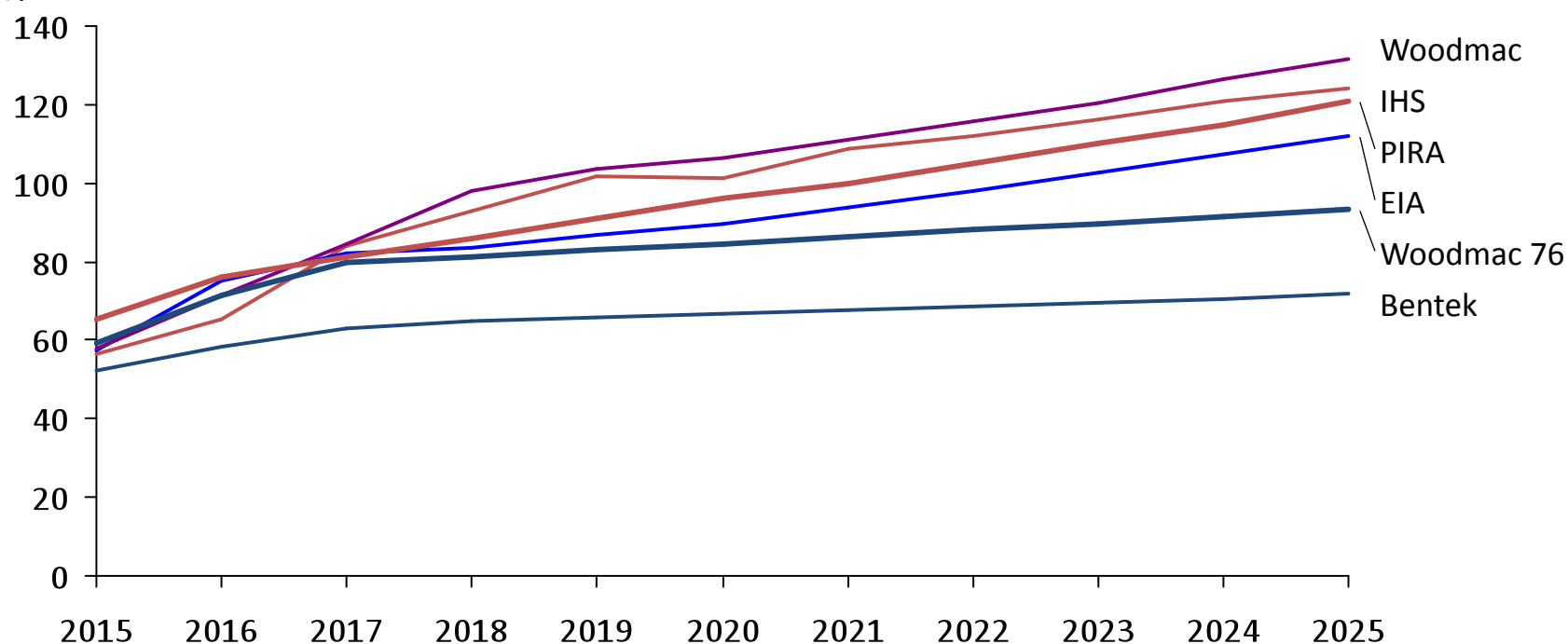
- Oil price uncertainty
- Feedstock price volatility
- EPC cost escalation

Business dynamics will have to play into supply-demand

Significant oil price uncertainty

Oil price forecasts

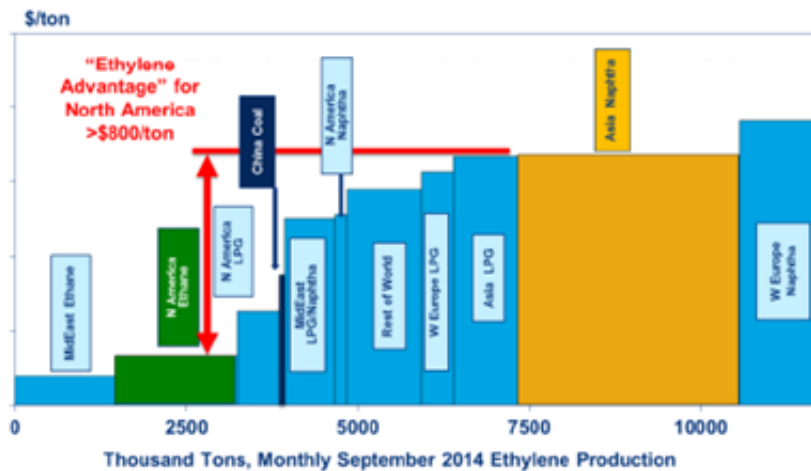
\$/bbl



Is the U.S. feedstock advantage large enough?

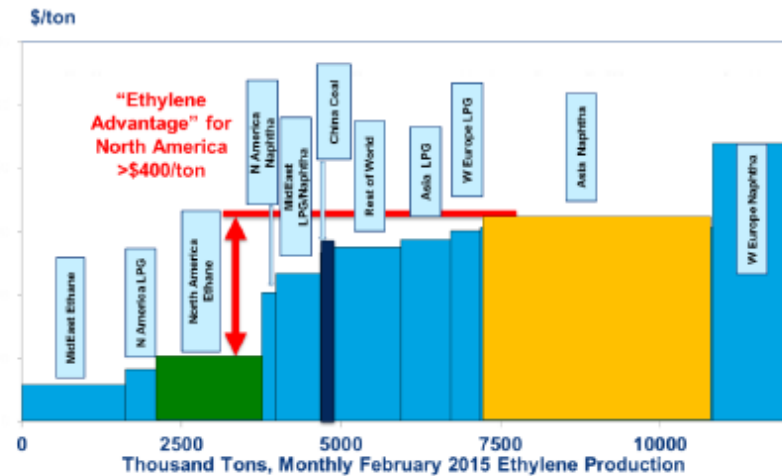
Margin compression over the different oil prices

September 2014 Global Ethylene Supply



September 2014
 Brent Crude Oil = \$98/bbl
 US Natural Gas = \$3.90/mmbtu
 US Ethane = 23cpg

February 2015 Global Ethylene Supply

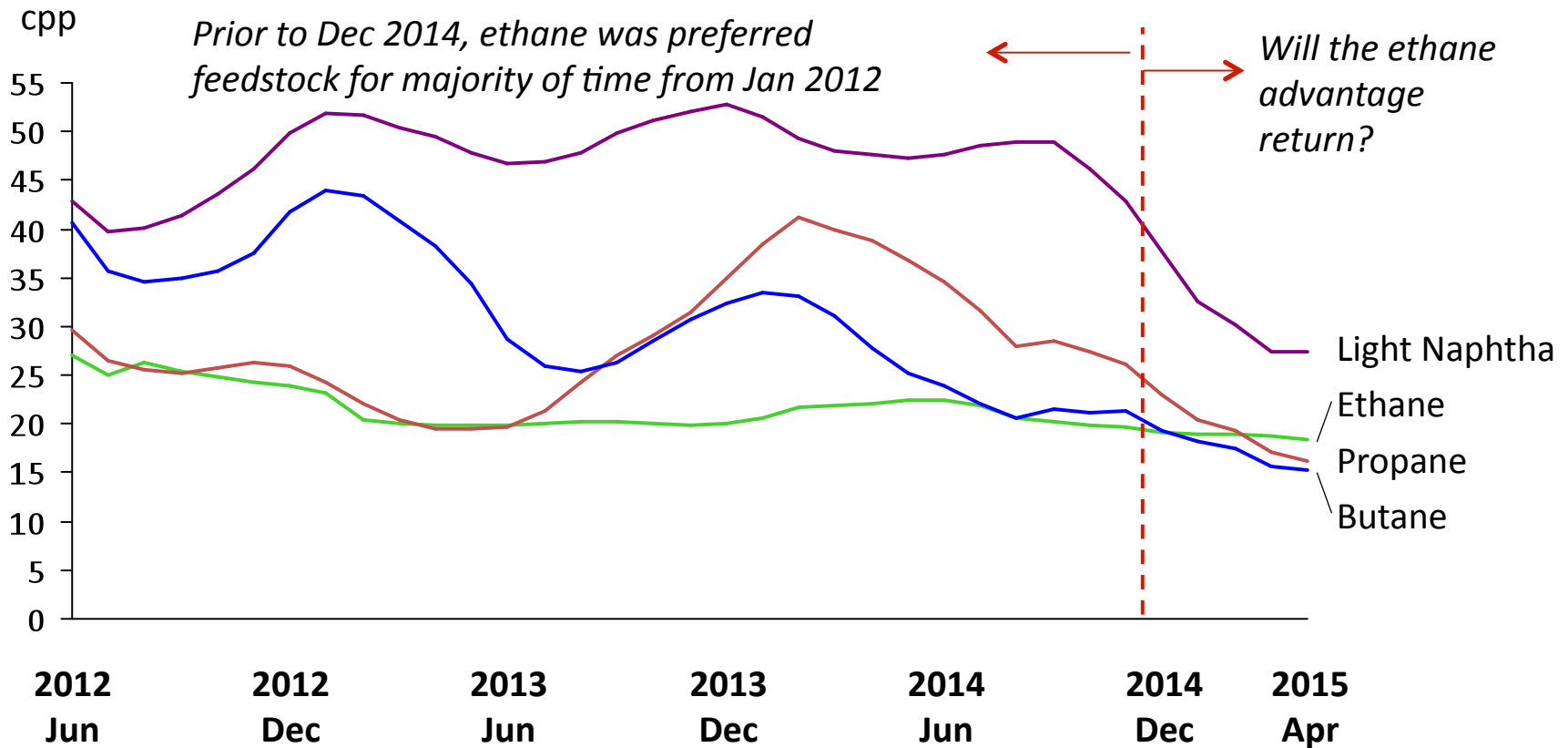


February 2015
 Brent Crude Oil = \$58/bbl
 US Natural Gas = \$2.65/mmbtu
 US Ethane = 18.5cpg

- North America will continue to be one of the most competitive petchem regions
- Will this competitiveness be sufficient to return the capital costs?

Feedstock volatility impacts plant design priorities

Ethylene costs (incl. co-product credit, capital returns¹), 6-months trailing average



Industrial and feedstock sourcing flexibility will continue to be important

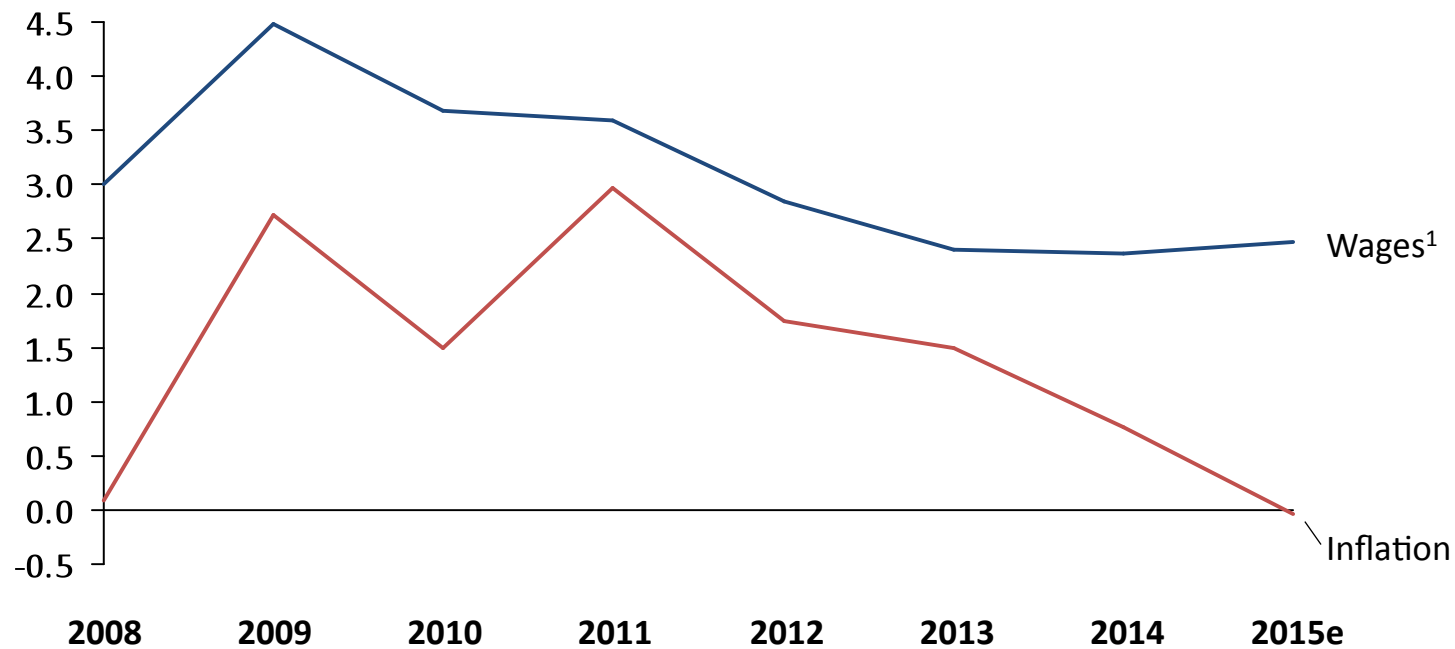
1. 10% Capital return on a 100% particular feedstock dedicated cracker

Source: Braskem analysis, IHS

1st Wave led to EPC cost escalation above inflation

Construction wages¹ and inflation escalation

% change year-over-year



Required expansion of labor force may create buffer for future construction boom

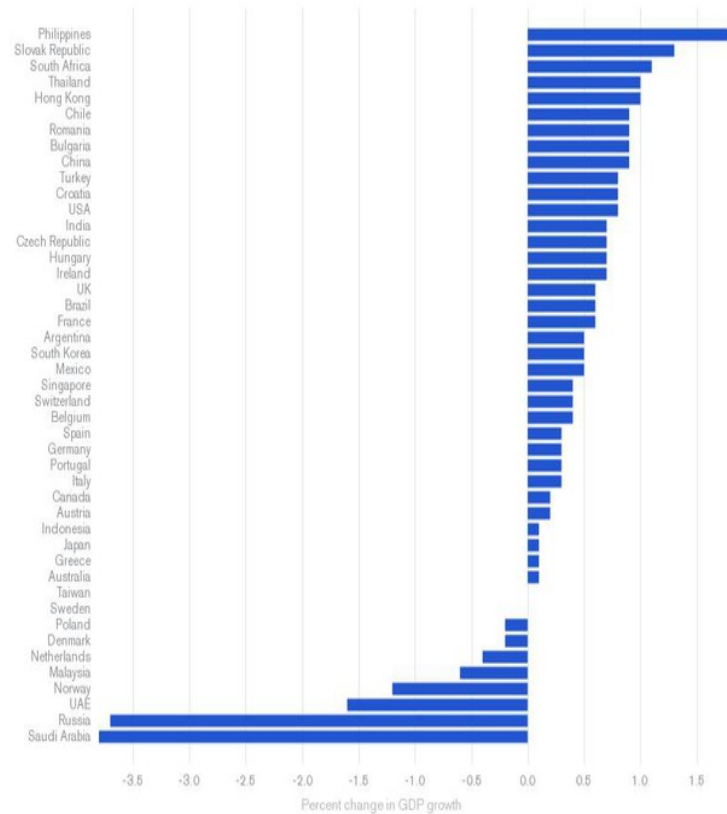
1. Based on wages for boilermaker, carpenter, cement mason, electrician, iron worker, laborers, operating engineers, plumber/fitter

Source: Wood Group wage data, US DOL, Braskem analysis

Lower oil prices leads to higher GDP, lower capacity

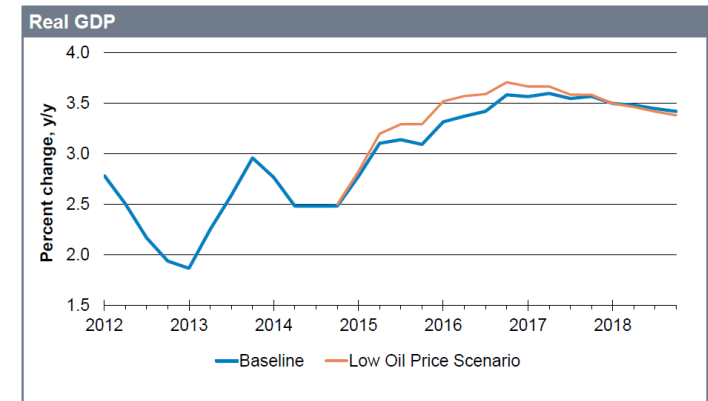
This is Your World on \$40 Oil

Effect on GDP growth in 2015-'16 of oil at \$40 a barrel vs. \$84



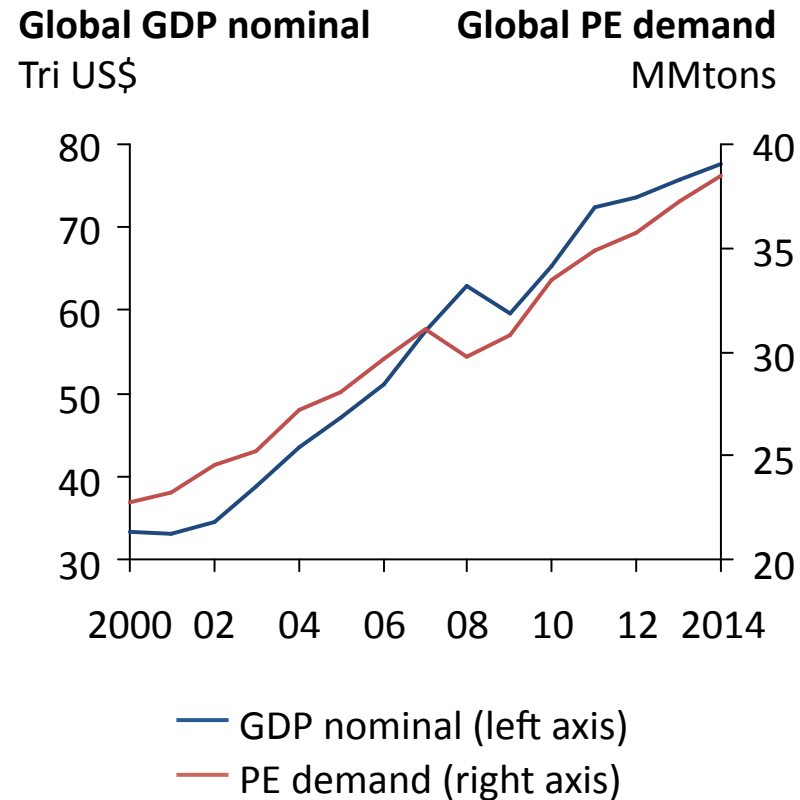
Source: Oxford Economics Ltd.

Bloomberg



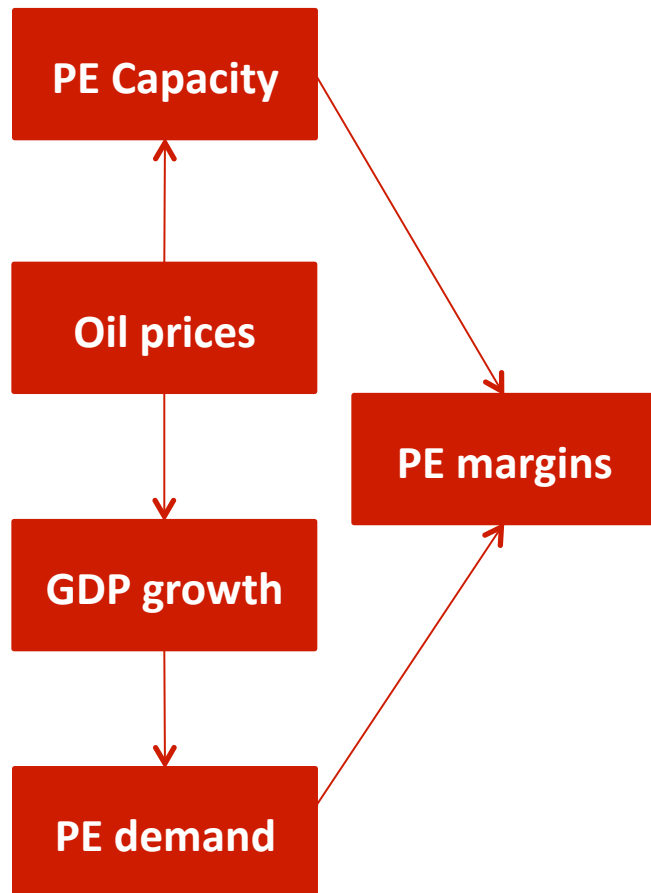
- Improvement of the global economic health
- Challenges to grow capacity at upcoming petchem centers (Russia, Middle East)

Higher GDP should stimulate increased PE demand

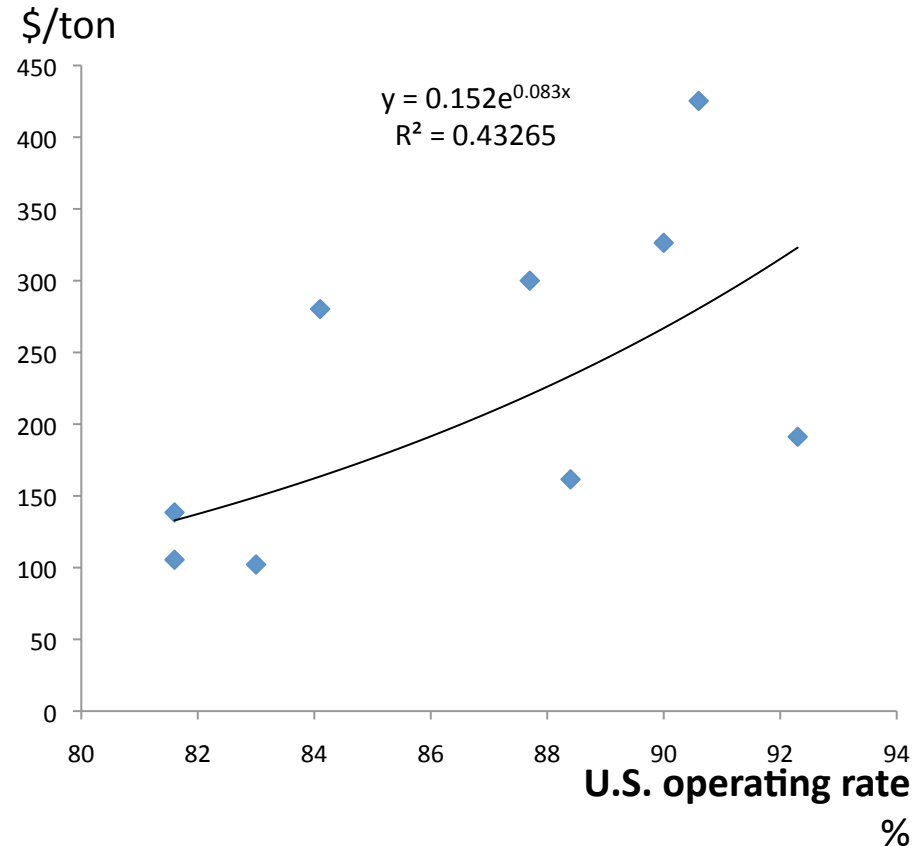


Global GDP-to-Demand elasticity of 1 – 1.5X

Tighter supply-demand drives higher utilization, margins



U.S. Ethylene margin, 2001 - 2011¹



- How fast will global GDP grow?
- How individual companies will take growth decisions?

1. Excludes the crisis years of 2008, 2009

Source: IHS data

Forthcoming evolution will define the speed of growth

Critical challenges

- Oil price uncertainty...
- Feedstock price volatility...
- EPC cost escalation...
- Supply-demand...

Level of influence

Fundamental aspect

Influence design, but is not a blocker

Might improve, but depends on “ground work”

Might improve, but: How fast? Which intensity?

The world needs crackers: U.S. is a good place for them

North American challenges

- Oil price uncertainty
- Feedstock volatility
- EPC cost escalation
- Export logistic bottleneck
- Exchange rate appreciation

North American benefits

- Feedstock availability, cost advantage
- Robust O&G industry
- Conducive investment climate: stability
- Market economy

The world needs 4-5 new world-scale crackers per year to satisfy the ethylene global demand growth