

PE Resin Market Dynamics

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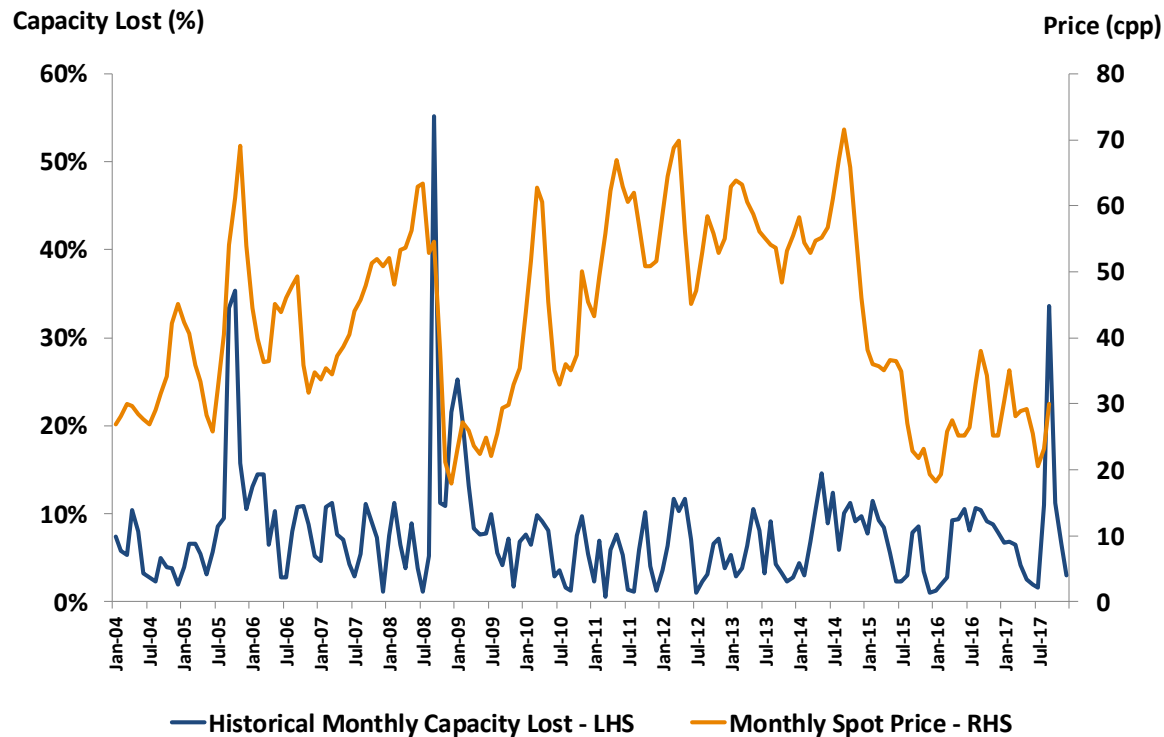
September 27, 2017

Discussion topics

Factors affecting business conditions will govern the impact of new capacity

- Macroeconomic conditions
- Crude oil / energy prices
- Supply and demand
- Cost advantage / disadvantage
- Reliability of assets

U.S. Ethylene Capacity Lost



Details of the impact of Harvey are still emerging:

- Substantial impact on operations
 - Most ethylene units have returned to normal operations
- For NA, ~6% unplanned outage level in late September, 14% including planned turnarounds
 - Difficult to know details, some units at reduced rates
- Approximately one quarter delay in CPC new cracker start-up to late Q1 2018

Other Impacts

Polyethylene:

- Most units appear to be operating, either at or approaching typical rates
 - Exception is CPC at Cedar Bayou, where an extended outage has been reported
 - NA Proportion: 7% HDPE, 8% LDPE, 3% LLDPE

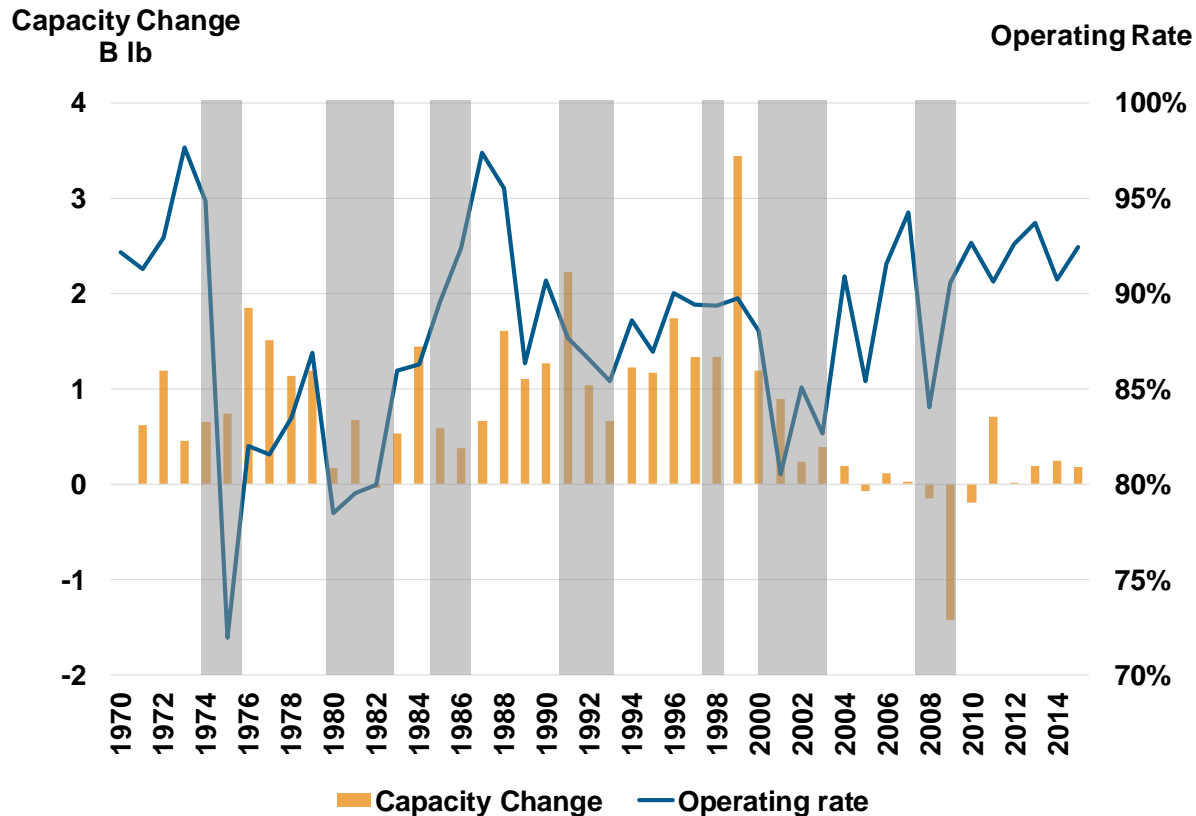
Logistics:

- In recovery
 - Pockets of congestion, few embargoed areas, impacts sometimes far-reaching

Comonomer:

- Extended outage at CPC Cedar Bayou LAO units
 - Hexene: ~30% of global and 60% of N. American supply
 - Some flexibility of full-range LAO units, trade, may mitigate

Historical Capacity Changes and Operating Rates



Key factors driving industry trough				
Period	Crude Oil	Economy	Cost Position	Capacity Growth
1974/75	XXX	XX		X
1980/82	XXX	XX		X
1985/86	XXX			X
1991/93	XX	XXX		X
1998	XXX			X
2001/03		XX	XXX	X
2008/09	XXX	XXX		

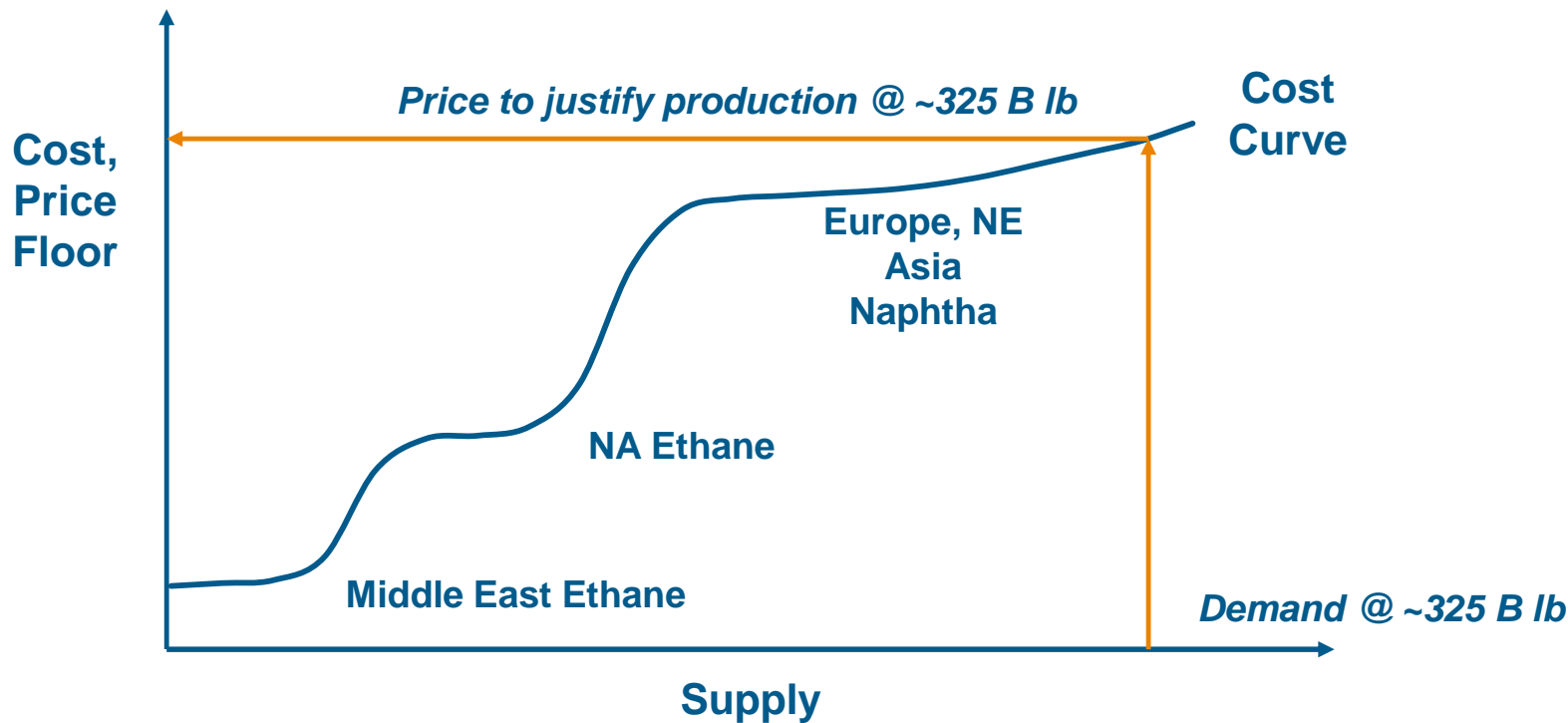
Potentially lower operating rates in NA going forward due to operability issues, not lack of demand

Global Industrial Production Growth

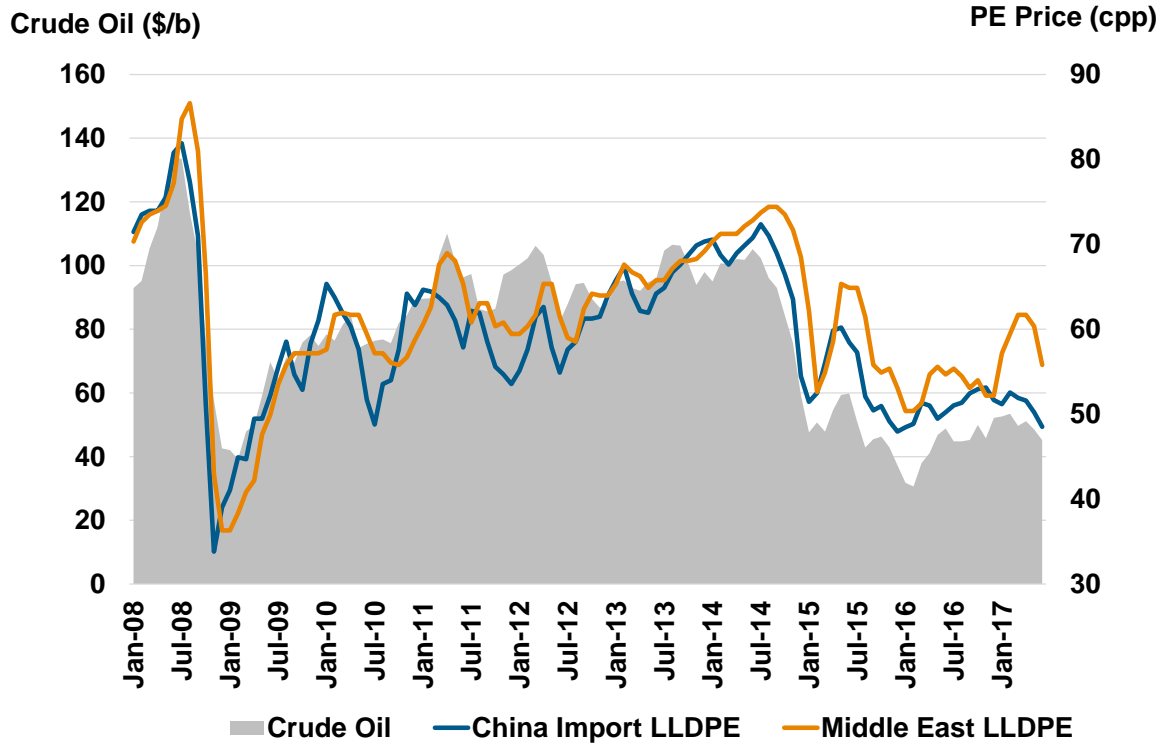


- Modest, synchronized upturn in economic growth in 2017
- Low probability of recession in next couple of years

Price Setting Mechanism – Ethylene Cost Curve

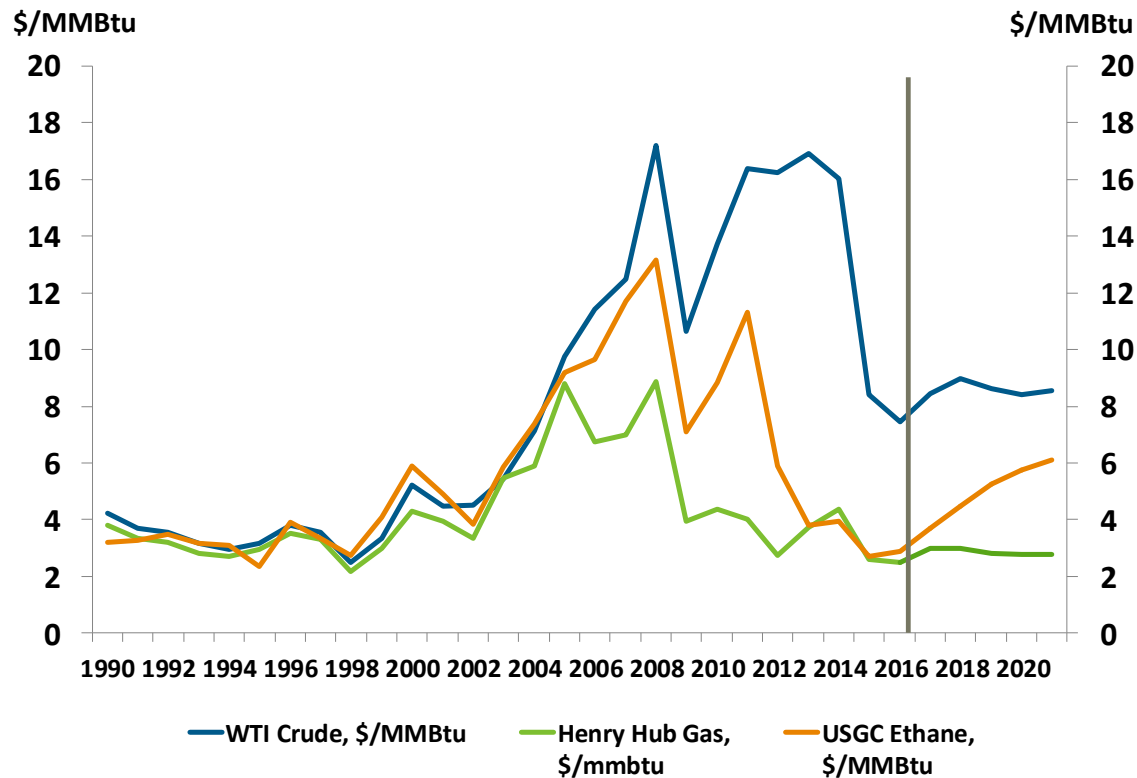


Crude Oil and PE Prices



- Crude oil and PE prices tend to move together, linked through naphtha
- PE prices in low-cost and high-cost regions similar
- Lower for longer the current consensus
 - Sustained lower than current prices unlikely
 - Consensus in 2014 was \$100/b...

Feedstock Relationships and Costs



Prior to 2005 / 2006

- No NA cash cost advantage

After shale development

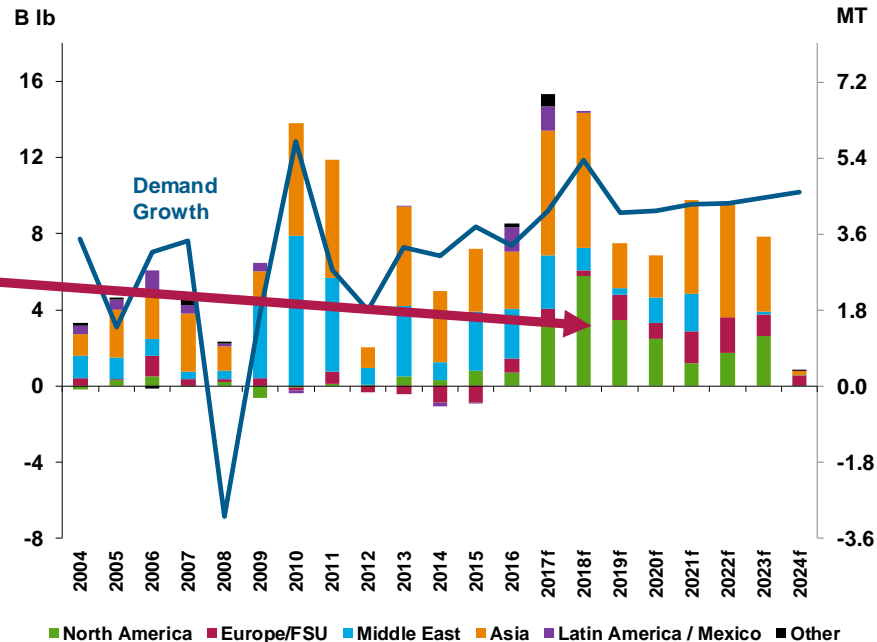
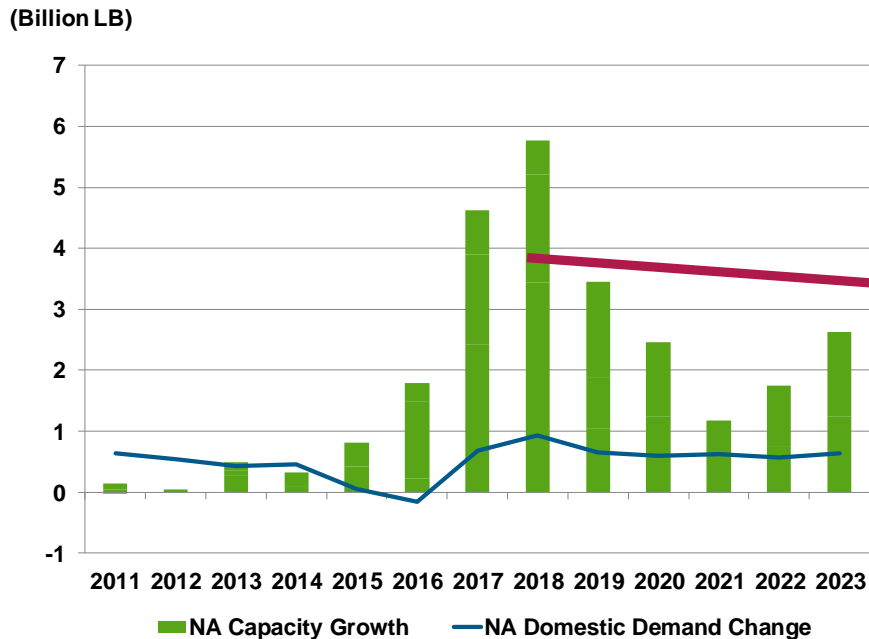
- Sustained advantage for NA ethane-based producers

- Export opportunities balance domestic market despite oversupply

Currently, looking forward

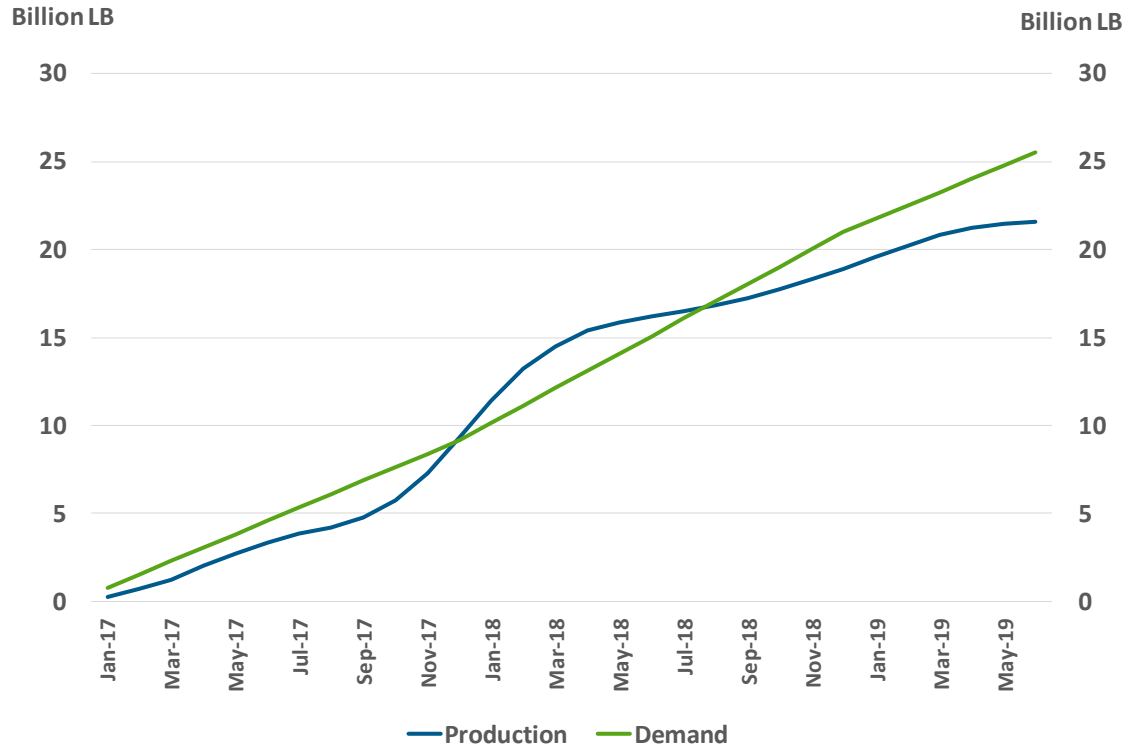
- Reduced advantage, but sufficient to support exports

NA and Global PE Capacity Expansions



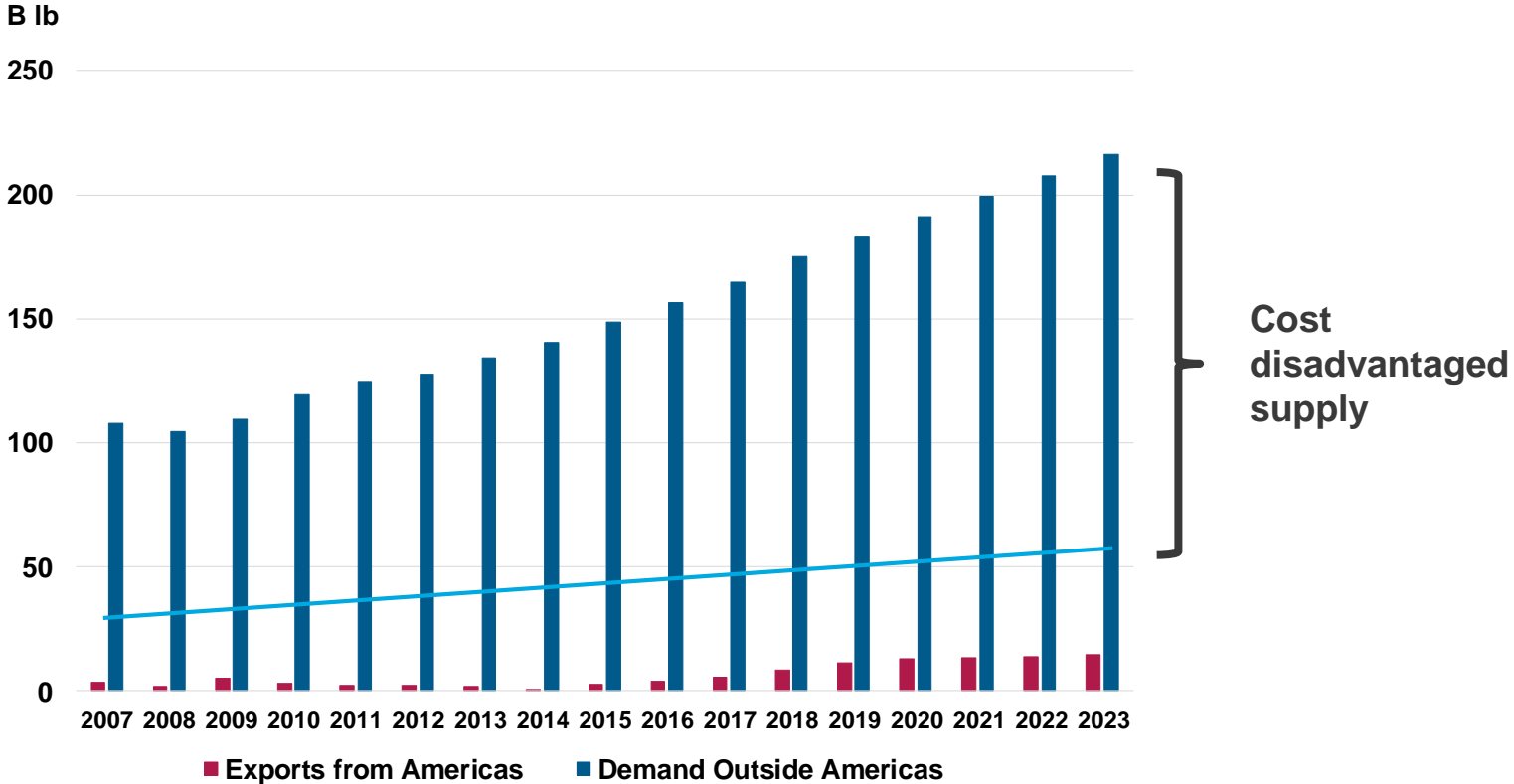
Global market needs North American supply

Global Production and Demand Growth Trajectory



- All new global capacity increases, including NOVA from end 2016
- No delays, latest start-up announcements captured
- 4-month ramp-up to 90%
- No ethylene constraints

Americas PE Exports and ROW Demand



Many factors affect business conditions

Economic growth

- Modest, synchronized upturn, low probability of recession

Crude oil prices

- Volatility, but general upward trend, lifts price floor

Supply and demand

- Global market needs new capacity being put in place here
- Unlikely to be significant imbalance in near term

Cost position

- Cost advantage to persist, exports continue to balance the N. American market
- Margins may be compressed as cost rises incrementally

Operational reliability

- Aging asset base, outages, may contribute to volatility



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