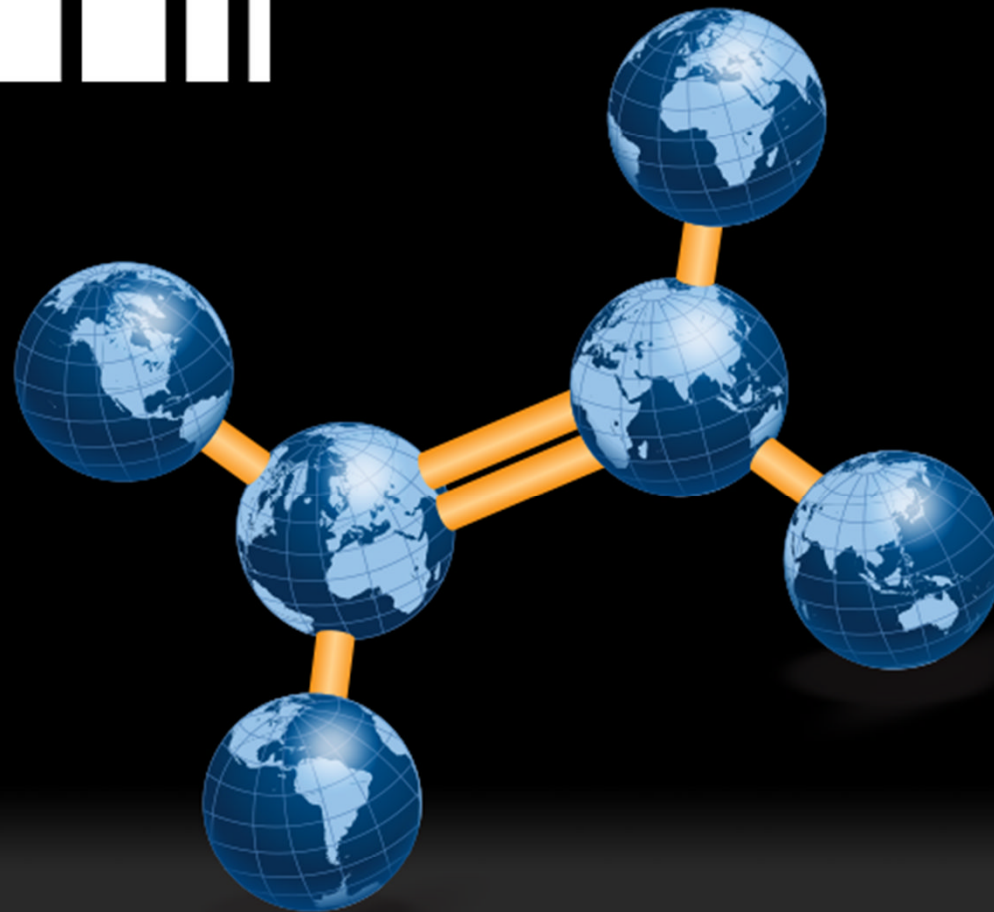


Inaugural Ethylene Forum

An Integrated Energy Perspective

Jorge Leis
Partner
Bain & Company

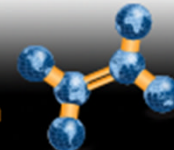


Technip



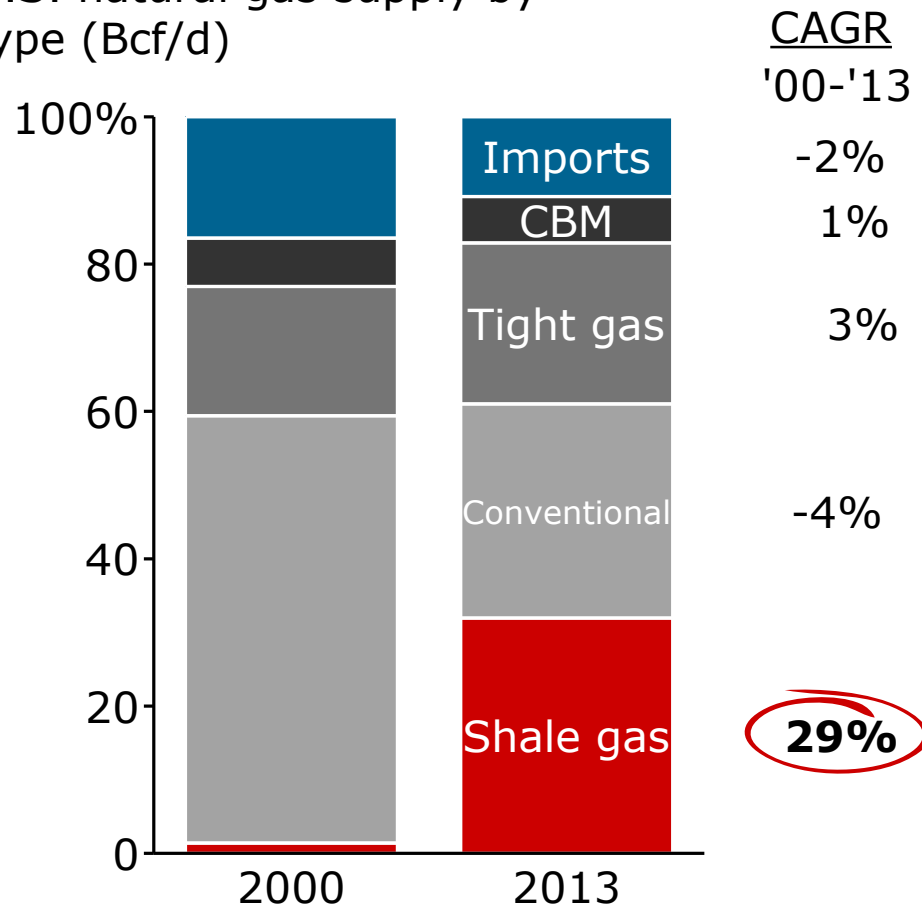
Today's objectives

- Briefly review the shale gas and tight oil phenomena in North America
- Highlight major trends and sources of uncertainty that will drive the evolution of the energy landscape
- Introduce a framework to deal with unprecedented uncertainty in energy markets
- Share summary thoughts on how energy scenarios impact the petrochemicals industry



The U.S. natural gas market has experienced a “supply shock” driven by the shale boom

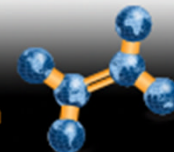
U.S. natural gas supply by type (Bcf/d)



Note: 2013 data is through end of July

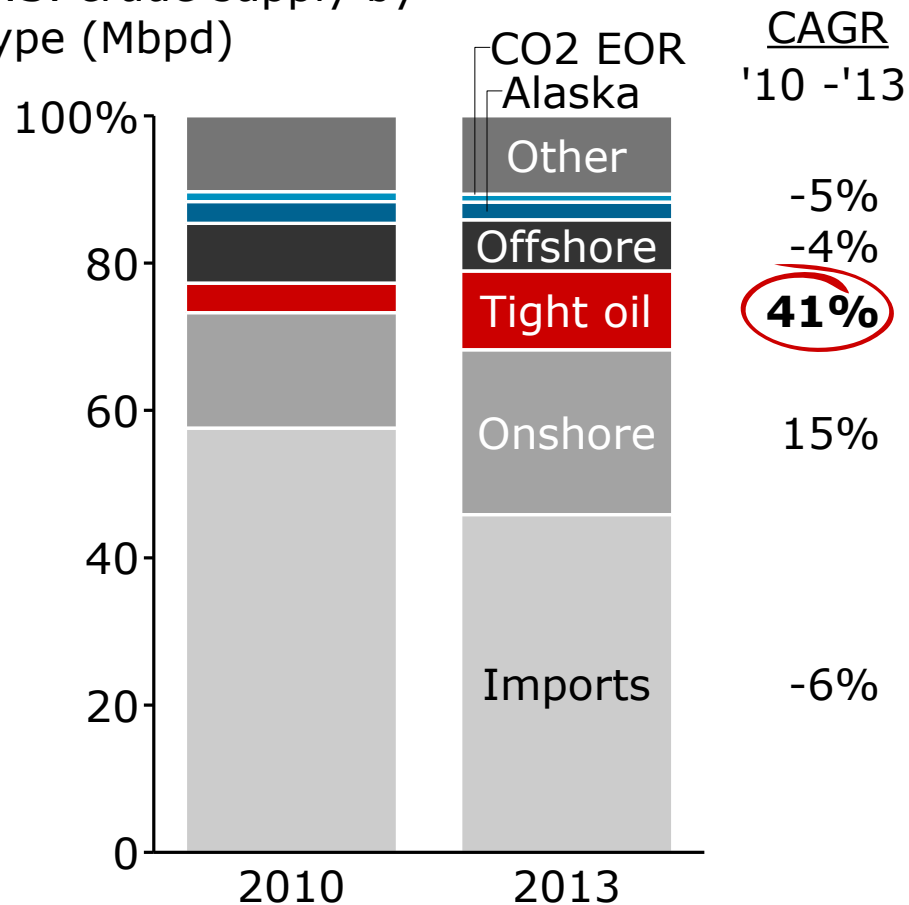
Sources: EIA, Deutsche Bank, Bentek, Wood Mackenzie, CAPP, Calgary Herald

- Shale gas is now the leading source of NG in the U.S.
- U.S. NG prices have decoupled from oil price – producing widely divergent global gas prices by region
- Lower NG prices have led to domestic substitution and opened up international arbitrage opportunities



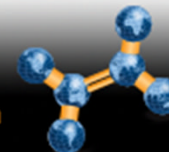
A similar boom is underway in U.S. tight oil, and crude sources are changing quickly

U.S. crude supply by type (Mbpd)



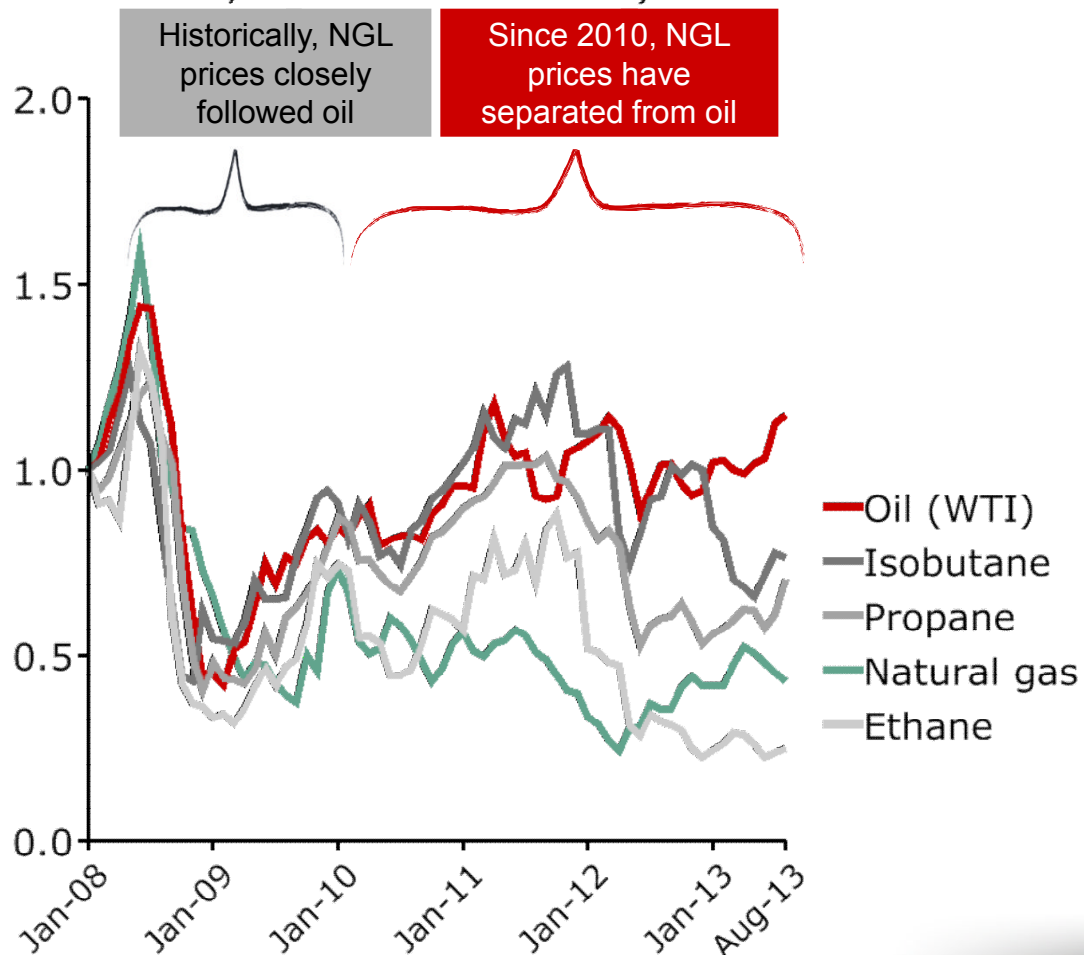
- Tight oil is fastest growing source of crude
- WTI price decoupled from world prices
- Lower-priced U.S. tight oil displacing light imports – heavy Canadian crude displacing U.S. heavy crude imports
- U.S. has become a net exporter of refined products

Note: 2013 data is through end of July
Sources: EIA, Deutsche Bank, Bentek, Wood Mackenzie, CAPP, Calgary Herald



As a result of wet gas production, NGL prices have decoupled from WTI and from one another

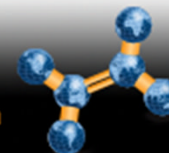
Oil and NGL prices
(2012 dollars, indexed to Jan 2008)



Source: Bloomberg, EIA, EPD Fundamentals, Enterprise Products Partners

BAIN & COMPANY

- Lower NGL prices have had a profound impact on the competitiveness of the U.S. petrochemicals industry
- Differing end uses require separate supply-demand analysis
- NGL prices still support attractive 'wet' well economics

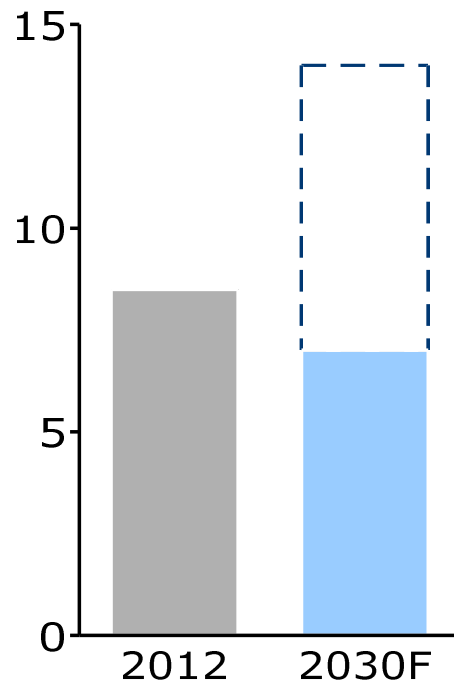




Uncertainty remains – wide variation in predictions of future U.S. oil and gas production

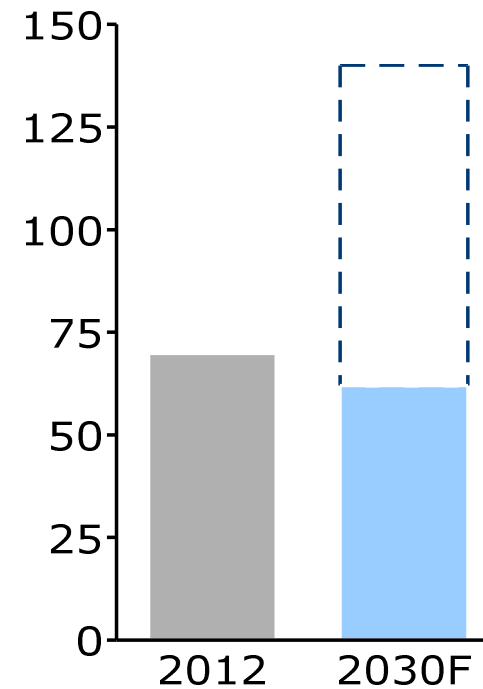
Crude Oil Production

MBPD



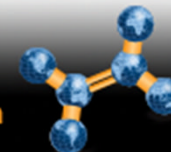
Natural Gas Production

Bcf/d



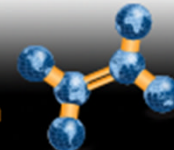
Source: Review of 2030 NA production forecasts

BAIN & COMPANY

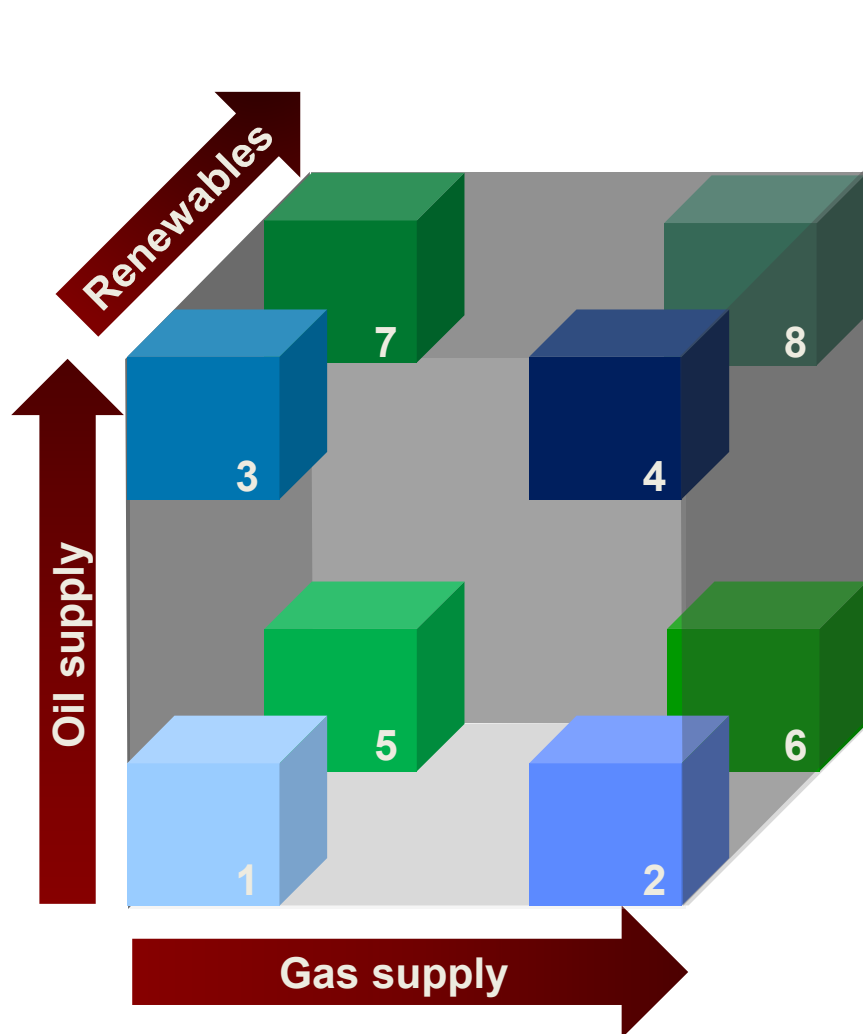


Bain perspective on better way to plan given the uncertainty in the energy markets

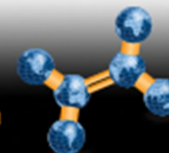
- Develop a tool to define and compare a set of intuitive, plausible scenarios:
 - Driven by potential supply shocks and inter- and intra-fuel substitution
 - Take into account inter-linkages between fuel supplies, intermediaries and demand markets
 - Take into account explicitly experience curves and substitution barriers
 - Collectively, explain a wide range of outcomes for production volumes and prices (“Corner Scenarios”)
- Define a methodology for tracking the evolution of the energy markets:
 - Identify the most important variables to monitor (“signposts”)
 - Define leading indicators to extend visibility into the future



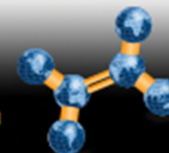
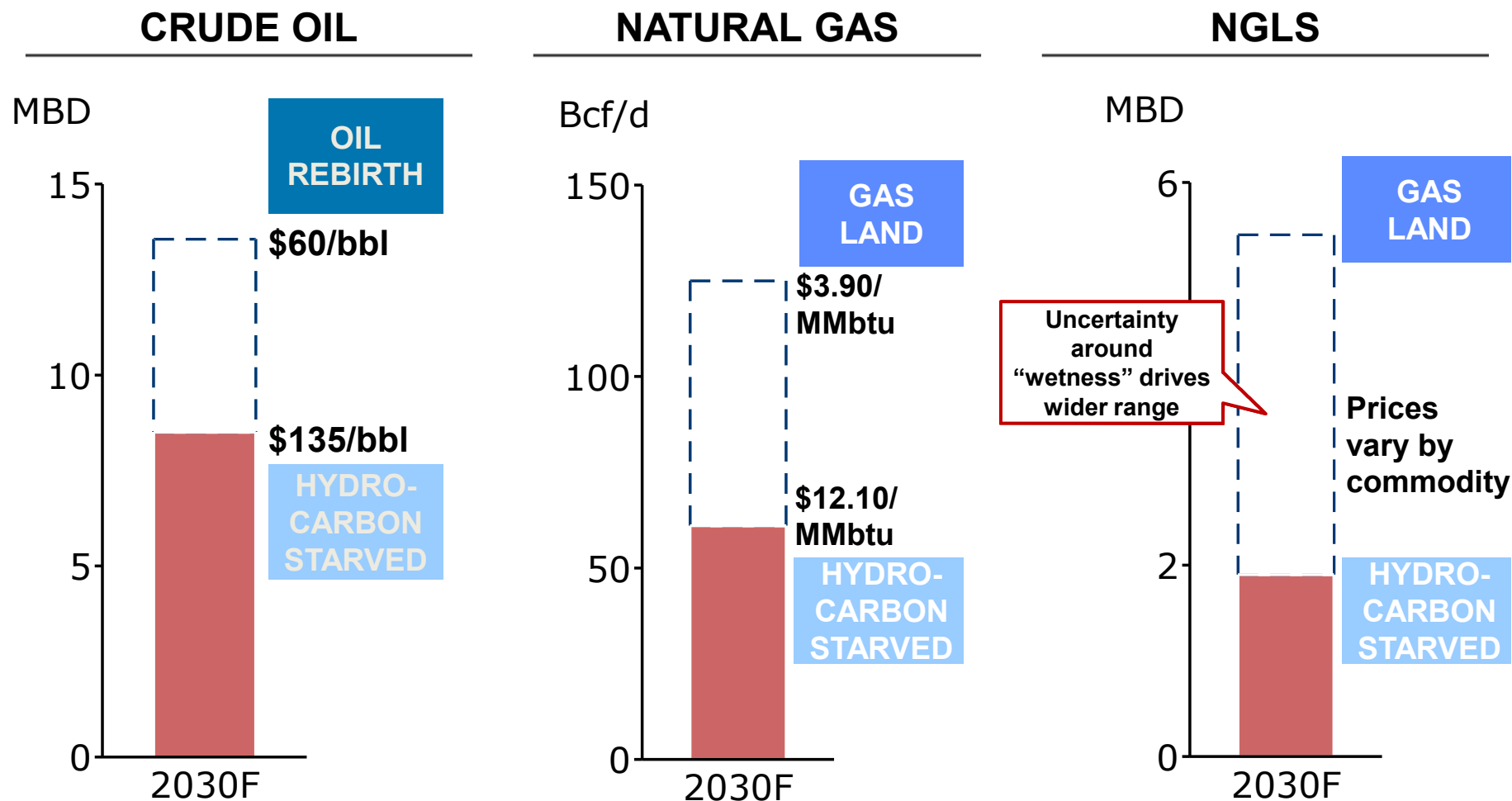
Permutations of supply levels for oil, gas and renewables define 8 'corner' scenarios



- 1 Hydrocarbon Starved** Tight oil and shale gas come in at "less optimistic" end of the spectrum
- 2 Gas Land** Limited tight oil; abundant shale gas
- 3 Oil Rebirth** Abundant tight oil; limited shale gas
- 4 Hydrocarbon World** Both tight oil and shale gas "hit big"
High oil and gas prices drive broad adoption of renewables
- 5 Green Nirvana** Continued innovation allows renewables to compete with gas
- 6 Green Breakthrough** Expensive gas and limits to oil power generation drive renewables adoption
- 7 Green Mandate** Tight oil, shale gas and renewables all "in the money"
- 8 Feuding Fuels**



Collectively, these scenarios cover a wide range of future potential U.S. production volumes and prices

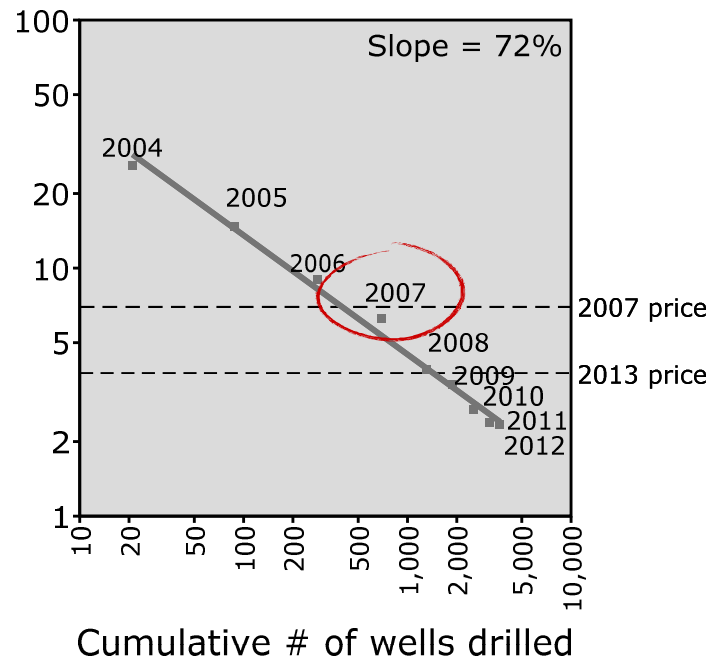


Two key concepts drive industry scenarios: experience curves and substitution barriers

SUPPLY:

Experience Curves are Best Predictors of Future Costs

SWN Fayetteville shale gas well costs
(\$/Bcf)



Source: Argonne National Lab, EIA, Google Trends, The Atlantic, SWN company financials; EIA; Bain analysis

DEMAND:

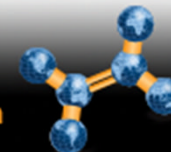
Substitution Barriers Inhibit Inter- and Intra-fuel Substitution

Inter-fuel Examples

- **Power generation:** slow replacement cycle for installed base of coal plants
- **Transportation:** lack of widespread LNG/CNG refueling infrastructure

Intra-fuel Examples

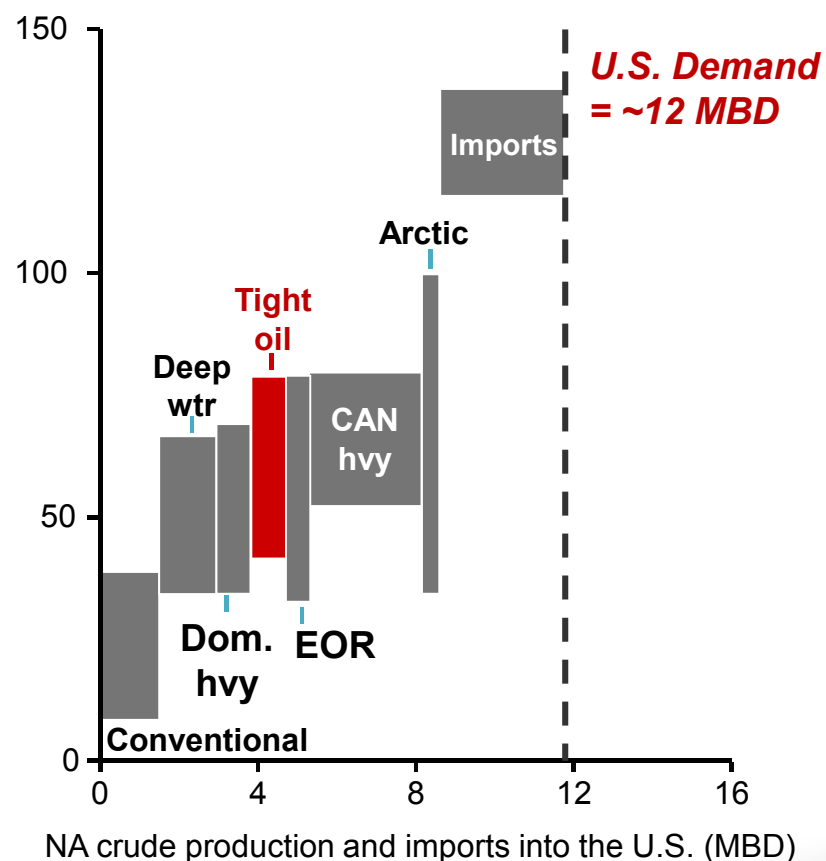
- **Pipelines:** bottlenecks preventing Bakken crude from reaching USGC
- **Export:** costs and lead time for LNG liquefaction and export facilities



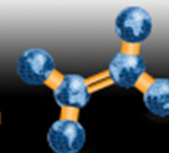
A low tight oil scenario paints a U.S. picture not unlike the status quo...

2030 Hydrocarbon Starved Scenario

Cost of production/import (\$/BBL)



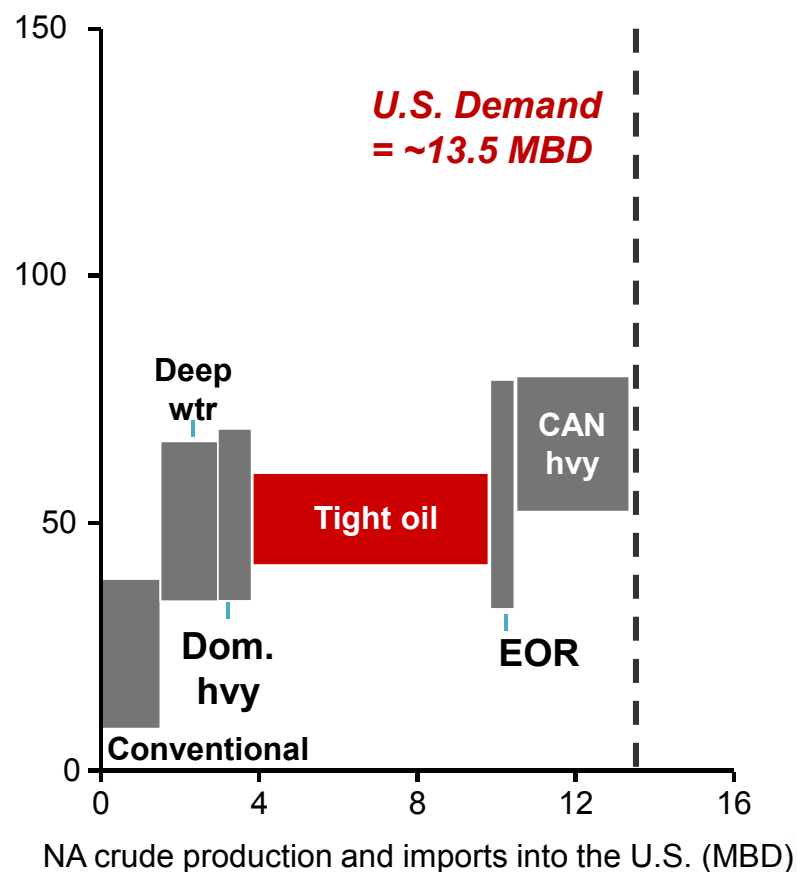
- Tight oil production plateaus in Bakken and Eagle Ford as best resource is drilled out
- None of the new plays in appraisal today “hit big” in the future
- Dependence on imports is reduced, but relatively little change from status quo



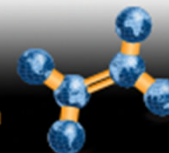
...but an Oil Rebirth scenario would have significant impact on U.S. supply, pushing out all non-N.A. imports

2030 Oil Rebirth Scenario

Cost of production/import (\$/BBL)



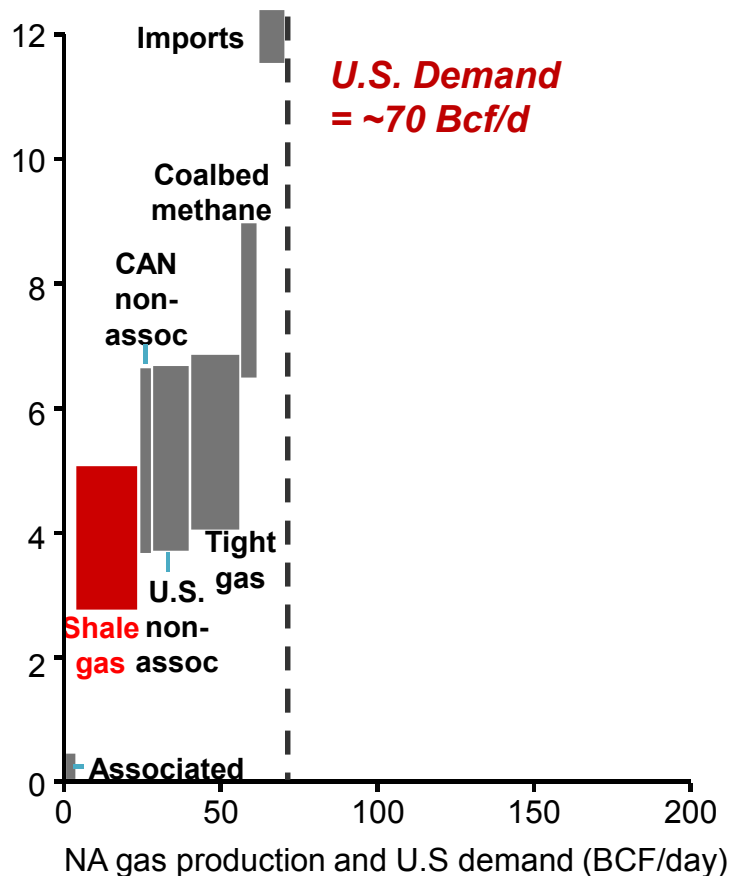
- Tight oil reserves estimates increase and recovery methods improve
- Increased production and learning improves cost position
- Surge in domestic production displaces nearly all imports (except Canadian heavy)
- Displaced foreign oil must find new markets – impact on Brent pricing



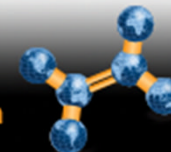
A low shale gas production scenario in North America would induce higher cost gas supply

2030 Hydrocarbon Starved Scenario

Cost of production/import (\$/MCF)



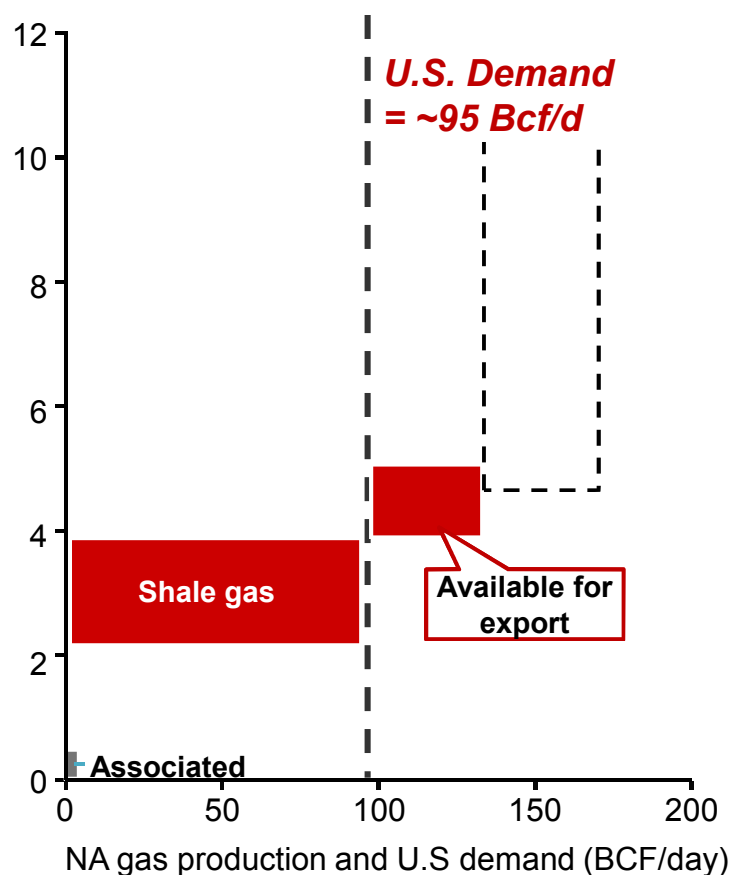
- Shale “sweet spots” are limited – high-EUR wells are not as pervasive as currently believed
- Shale cost reduction trends falter as activity slows and low hanging fruit is picked
- US returns to gas import status barring a significant reduction in demand



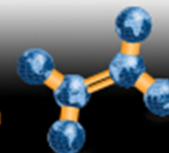
Impact of a Gas Land scenario in North America would result in persistent (and sustainable) low gas price

2030 Gas Land Scenario

Cost of production/import (\$/MCF)

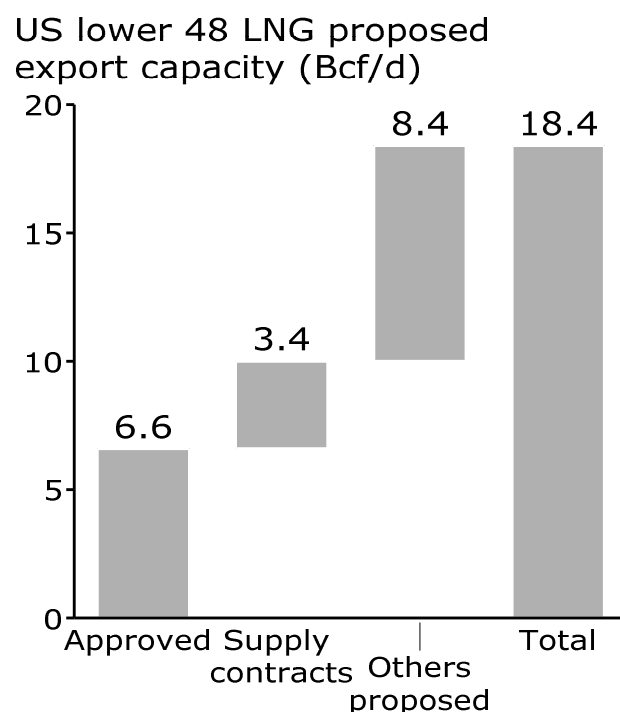


- Improvement in recovery techniques expands size of “sweet spots” and continues lowering costs
- Potential to push all other sources of NG “off the supply curve” and support high levels of LNG exports
- Low-cost NG expands domestic demand by ~30%



There is significant uncertainty around how much LNG the U.S. will ultimately export

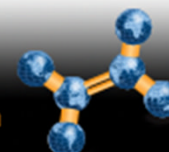
LNG Export Facilities Proposed



Sources of Uncertainty

- 1 Global demand**
 - Already aggressive projections are edging upwards
- 2 U.S. regulatory approval**
 - 4 facilities approved to date
 - FERC, DOE approvals will proceed one at a time
- 3 EPC constraints**
 - Concurrent construction of multiple facilities will strain EPC capabilities; likely lead to continued cost inflation
- 4 Competitive LNG supplies**
 - ~50 LNG facilities being built or planned; many with rated lower landed cost vs. U.S.
 - High variability for on-time and on-budget
- 5 China supply-demand balance**
 - Aggressive policy push toward use of natural gas in favor of coal
 - Three-pronged supply strategy: pipeline, LNG and shale

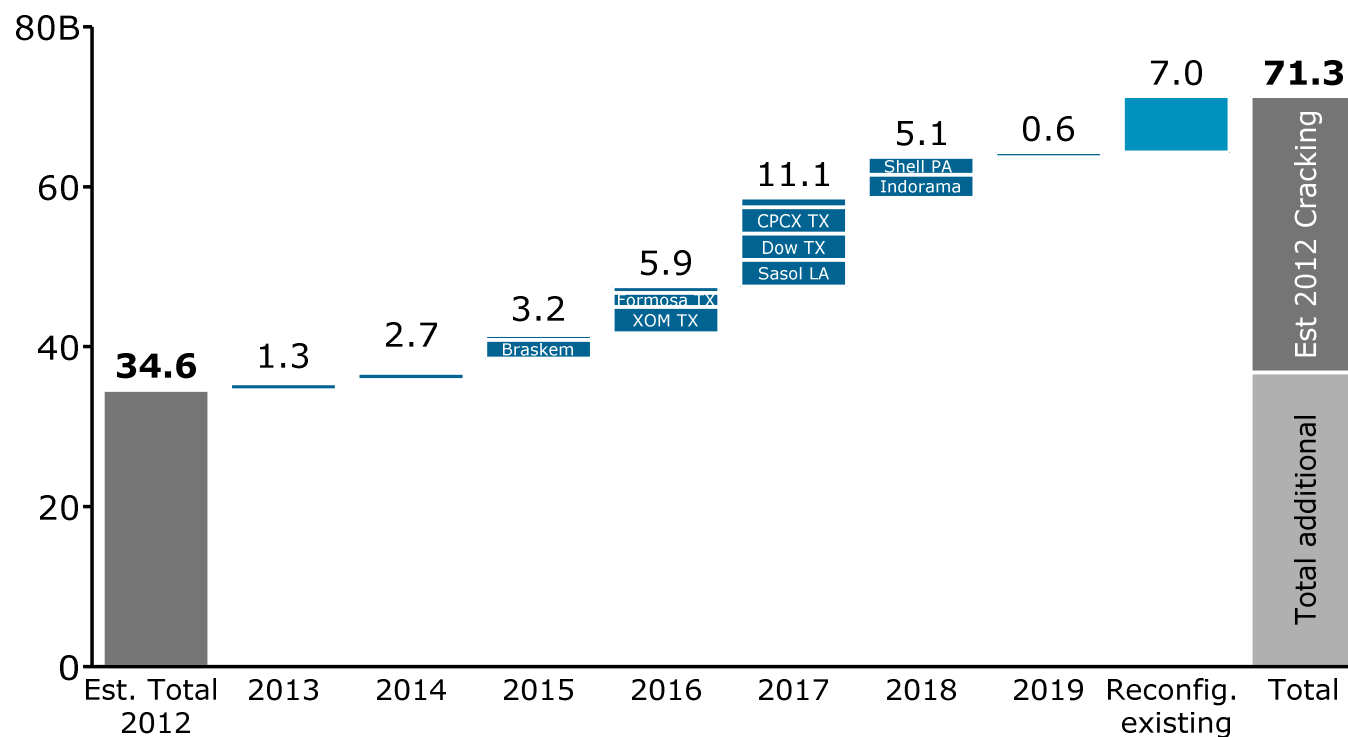
Sources: BP, BG, Department of Energy, Bloomberg, Platts



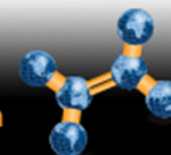
Ethane cracking capacity projected to double in North America by 2020

ETHANE

Ethane requirements for additional planned ethane crackers (lbs/yr)



Note: Assumes 100% ethane feedstock in new capacity; new steam crackers take 4-5 years to build; analysis includes plants that are expected, but not completely certain, to come online by 2020
Source: Literature research; Company websites; Bain analysis; ICIS; Oil & Gas Journal

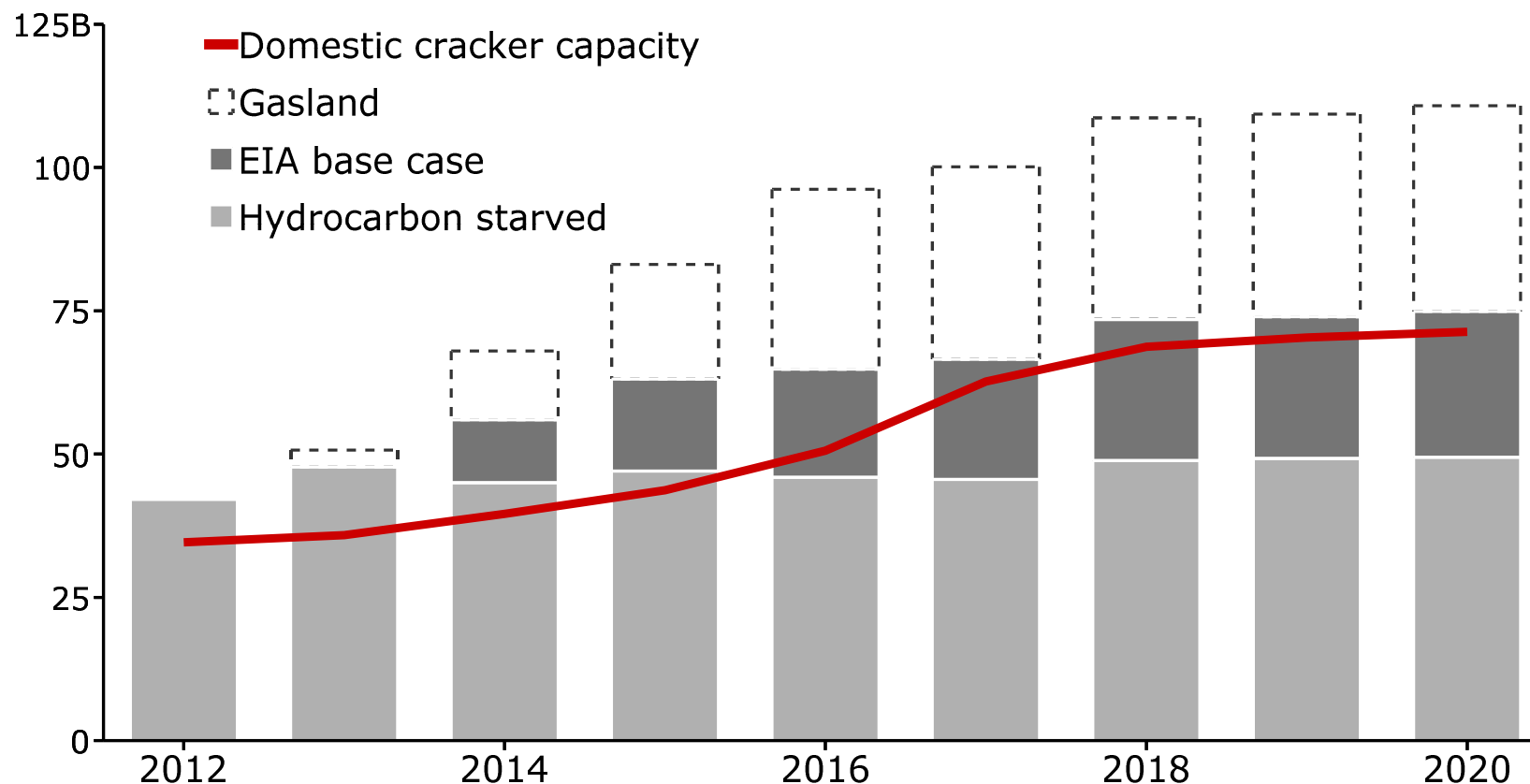




However, plausible low and high cases for ethane result in very different supply-demand outcomes for crackers

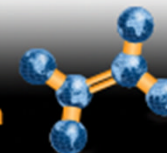
US ethane demand vs. supply
(lbs/yr)

ETHANE



Note: Ethane-starved supply based on percentage difference between EIA high and low cases – current analysis is closely tied to EIA's high case

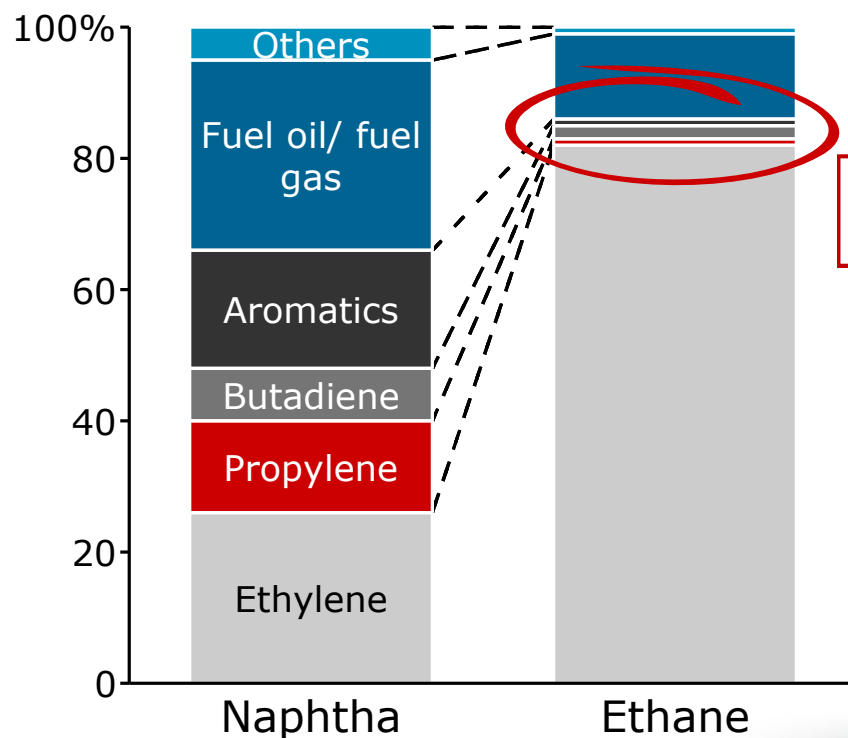
Source: EIA - Annual Energy Outlook 2013; Wells Fargo May 2013; Morgan Stanley May 2013; Bentek May 2013; company websites; lit. search



Second order effects: shift to ethane crackers in U.S. could create a shortage of typical naphtha yields

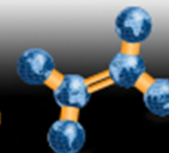
Ethane Cracking Primarily Yields Ethylene – At Expense Of Other Outputs

Yields by feedstock type, per ton of ethylene



Butadiene and aromatics receiving most attention as possible import opportunities into the U.S.

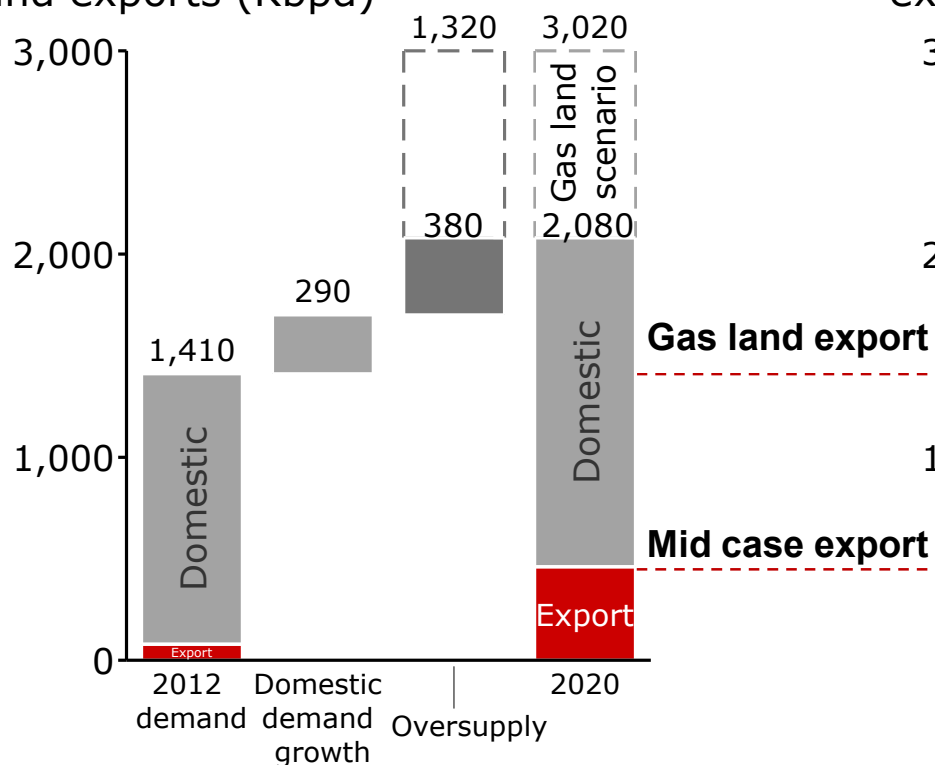
Source: Deutsche Bank Petrochemicals Yearbook 2011; SRI CEH Marketing Research Report 2011 for Propylene and Butadiene; Datastream



A continued surge in LPG supply will require export capacity to balance the market

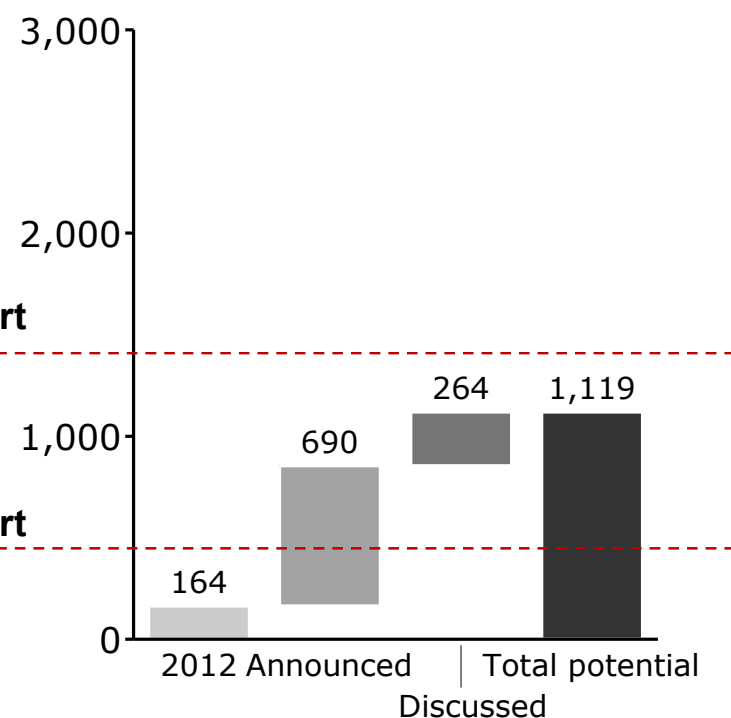
Domestic LPG Oversupply

US domestic LPG demand and exports (Kbpd)

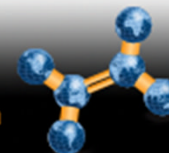


Planned Export Capacity

Existing and announced USGC LPG export capacity (Kbpd)

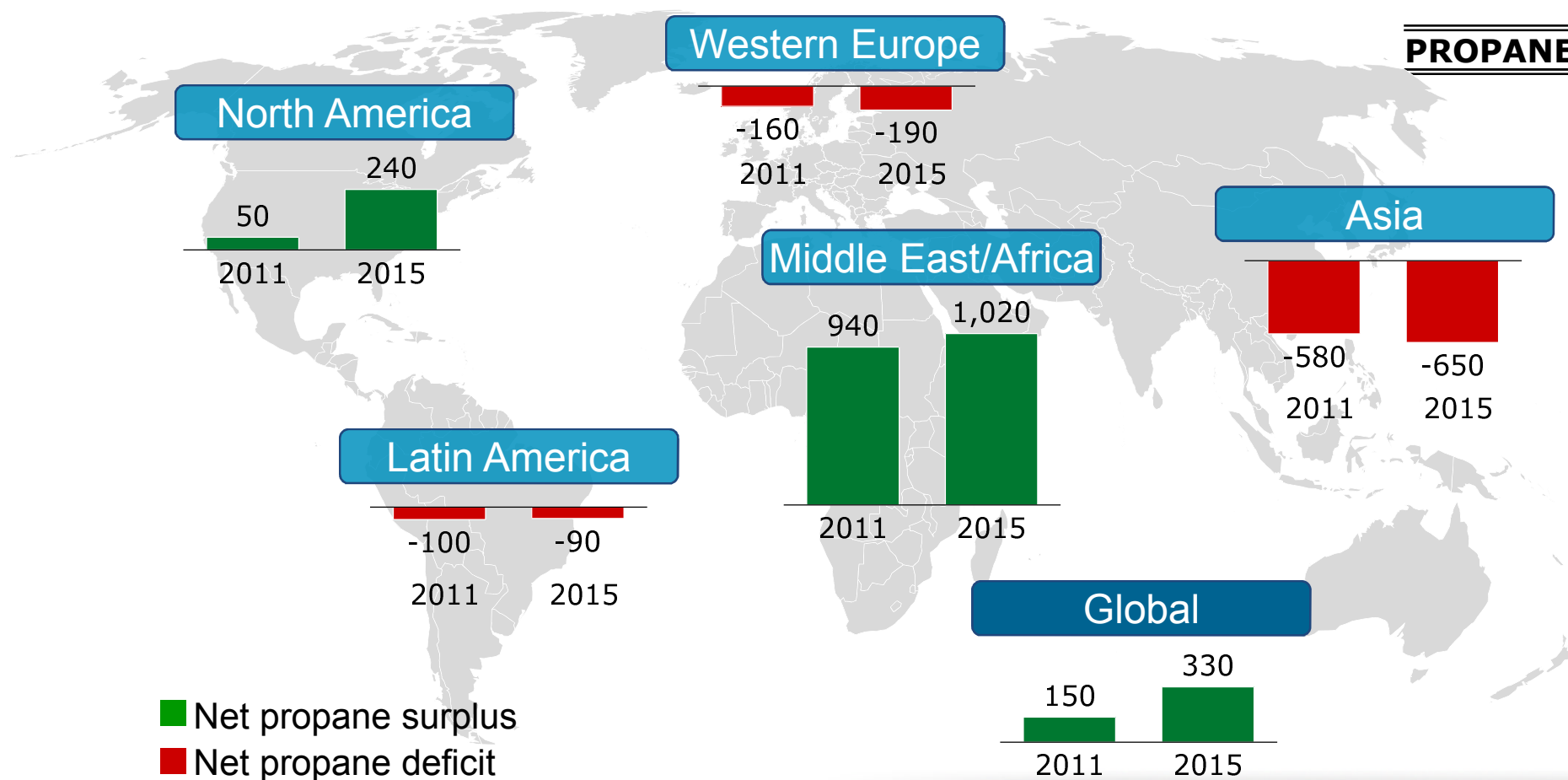


*Note: Export capacity numbers assume LPG export facilities run at historical utilization rate of 86%
Source: Goldman Sachs, Wells Fargo, Morgan Stanley, company press releases

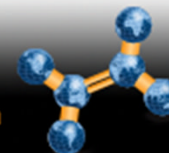


Key question will be whether global LPG markets can support new seaborne supply from the U.S.

Example: short-term world propane balance (Mbpd)



Source: Goldman Sachs, Wells Fargo, Morgan Stanley



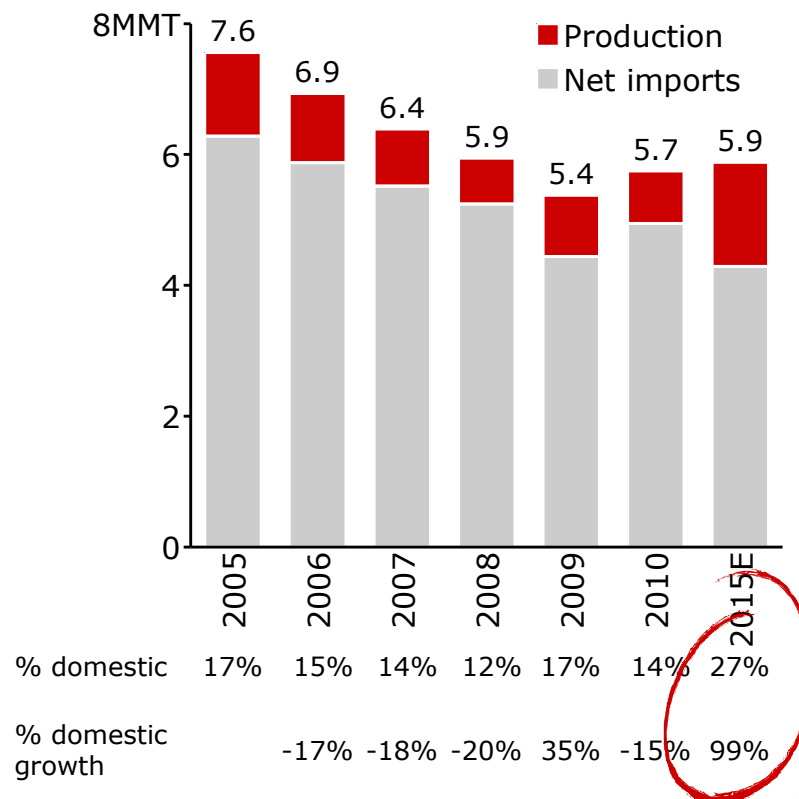


Second order effects: low natural gas prices inducing expansions in domestic methanol production capacity

METHANOL



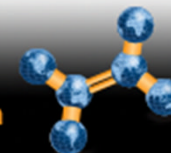
US Supply-Demand of Methanol



- Investing ~\$1B to build a new methanol plant in Texas
- Capacity of 1.3 MMT per year, as feedstock for acetyls production



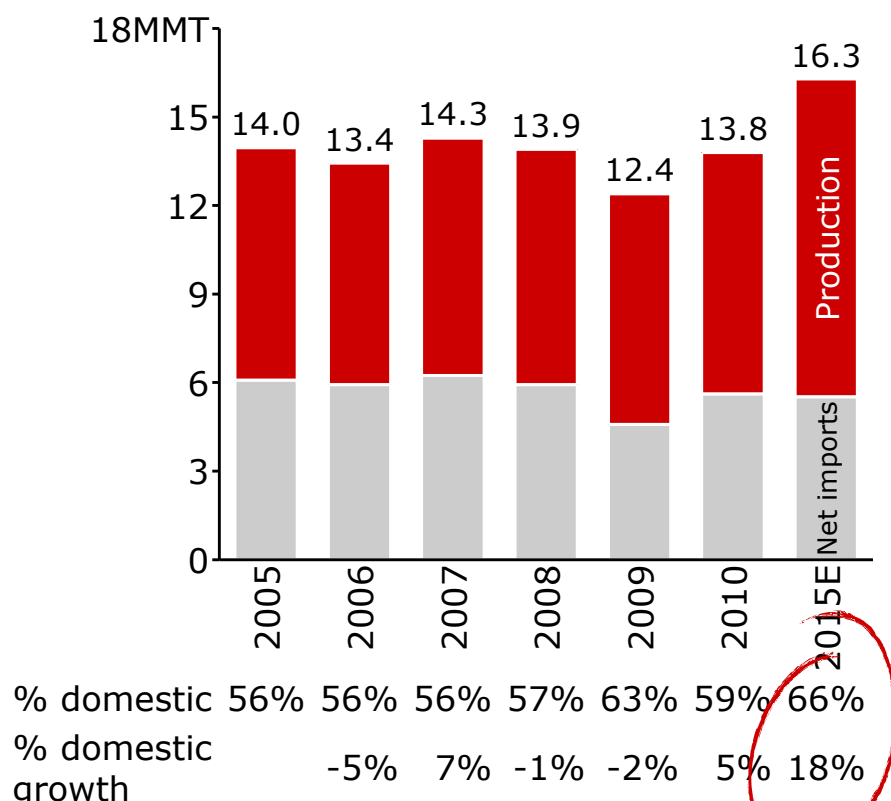
- Moving two methanol plants from Chile to Louisiana
- Cost of >\$1B



Second order effects: resurgence in U.S. ammonia plants planned due to low-priced gas feedstock

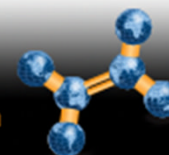
AMMONIA

US Supply-Demand of Ammonia



Surge in Domestic Ammonia

- No new ammonia US plants in 20 years
- Currently, 14 proposed ammonia plants planned over next 3-5 years
- Up to 12 MMT new capacity by 2018 and \$10B total investment
- Example: PotashCorp resuming ammonia production at previously dormant US plants



Strategy, as traditionally designed, is about clarity and alignment from ambition to execution



Bold, inspiring full potential ambition



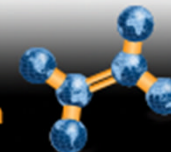
Clear choices on where to play and how to win



Initiatives and capabilities to repeat success



Plan and routines to align the front line



In periods of heightened uncertainty, strategy creation can fall into two common traps

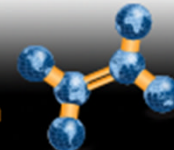
UNDERCONFIDENCE

- ✗ *Treating uncertainty as “unknowable”*
- ✗ *Focusing only on things that can be controlled*
- ✗ *“Wait and see” stance on market changes*
- ✗ *Doubling down to protect incumbency*
- ✗ *Few innovation bets*
- ✗ *A bet on every square to manage risk*
- ✗ *Lack of direction in front line execution*

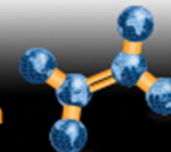
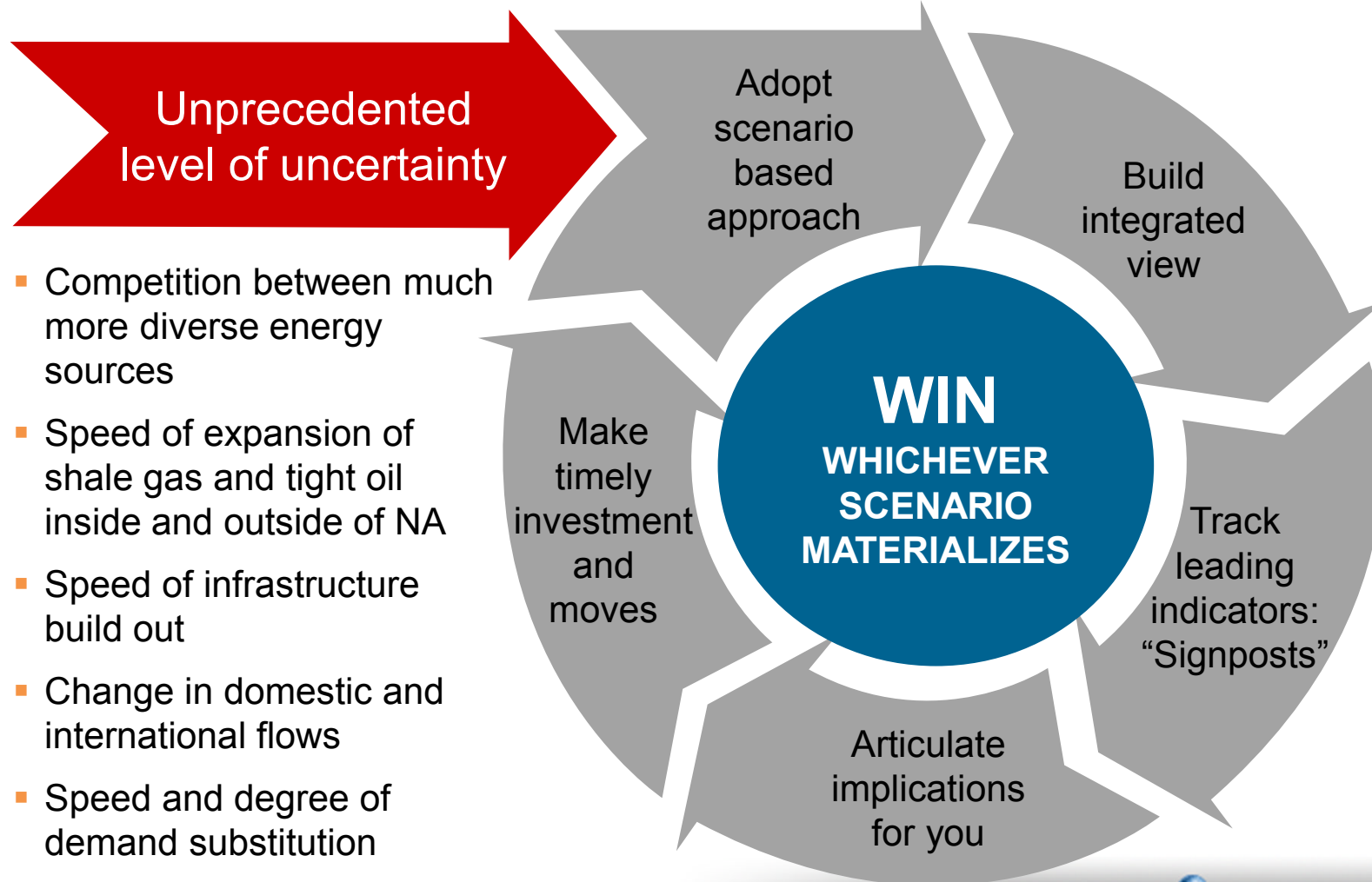


OVERCONFIDENCE

- ✗ *“Rifle shot” views of the future*
- ✗ *Bold, but unrealistic or vague ambition*
- ✗ *Failure to anticipate competition*
- ✗ *Rigid pursuit of new business models*
- ✗ *Big and monolithic bets that create “lock-in”*
- ✗ *Little or no focus on risk management*
- ✗ *Heads down and rigid execution*

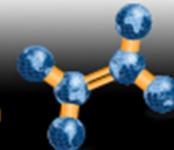


Strategy in an environment of high uncertainty requires a non-traditional approach



Strategies using this approach have a number of advantages

- Strategies are developed that **are robust under multiple scenarios**
 - Clear **“no regrets”** moves
- Strategies have built-out element of **optionality**
- Improved **capability to monitor** the environment provides visibility 3-5 years out into the future further than today's strategies
 - Experience curves
 - Substitution barriers
 - Key technological developments
- **Clear decisions** are triggered when signposts flash “red” prior to imminent change in the environment
- Signposts accord greater **time to execute** and adjust



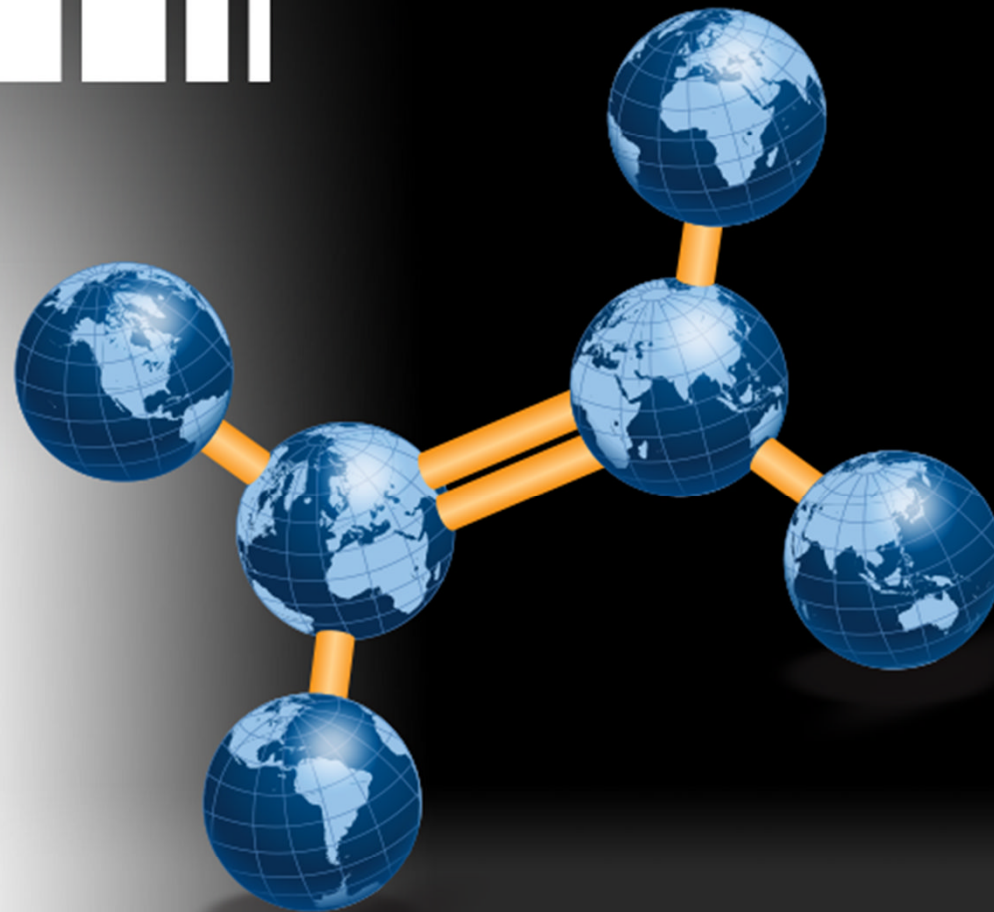
Inaugural Ethylene Forum

An Integrated Energy Perspective

Jorge Leis

Partner

Bain & Company



The material appearing in this presentation is for general information purposes only. Technip S.A. and its affiliated companies ("Technip") assume no responsibility for any errors or omissions in these materials. TECHNIP MAKES NO, AND EXPRESSLY DISCLAIMS ANY, REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, REGARDING THE MATERIALS CONTAINED IN THE PRESENTATION, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Under no circumstances shall Technip, the other sponsors, presenters and any of their respective partners, officers, directors, employees, agents or representatives be liable for any damages, whether direct, indirect, special or consequential, arising from or in connection with the use of materials and information contained in the presentation. The materials contained in this presentation may not be reproduced, republished, distributed, or otherwise exploited in any manner without the express prior written permission of Technip.