

Natural Gas Utilization via Small-Scale Methanol Technologies

Natural Gas Utilization Conference
October 14, 2014



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Outline

- ▶ **About ADI Analytics**

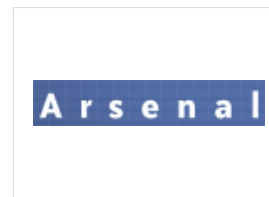
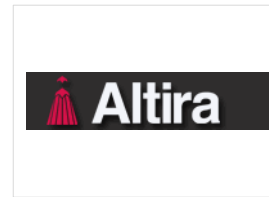
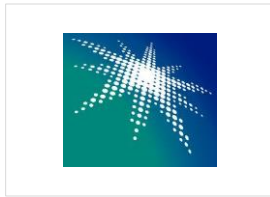
- ▶ Gas Utilization and Low Oil Prices

- ▶ Small-Scale Methanol Technologies

ADI Analytics is a boutique consulting firm serving energy and chemical companies with passion, rigor, and expertise

	Markets	Technology	Operations	Functions
Oil & Gas	 Exploration	 Production	 Refining	 Distribution
Power & Mining	 Coal	 Generation	 Transmission	 Carbon
Renewables & Cleantech	 Biomass	 Solar	 Wind	 Geothermal
Chemical & Industrial	 Plastics	 Materials	 Auto	 Manufacturing

Fortune 500 and mid-sized companies, start-ups, investors, and governments have hired us to shape decisions globally



Outline

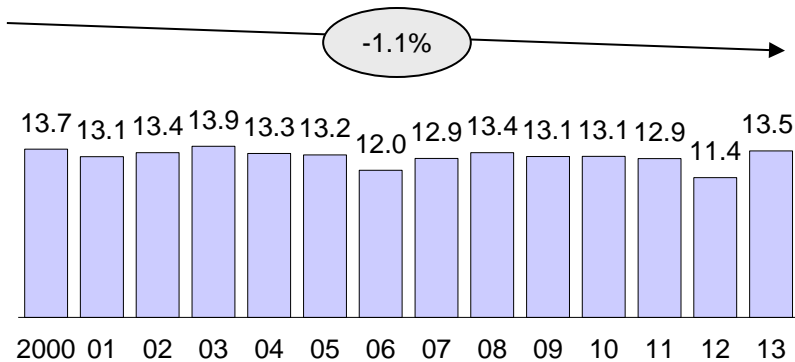
- ▶ About ADI Analytics

- ▶ **Gas Utilization and Low Oil Prices**

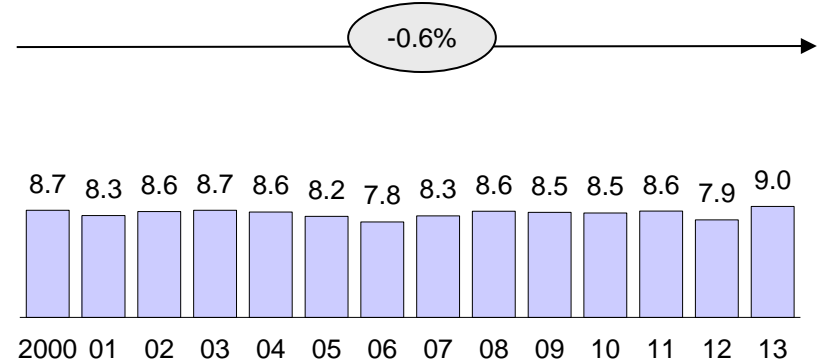
- ▶ Small-Scale Methanol Technologies

North American demand for gas is being driven by power

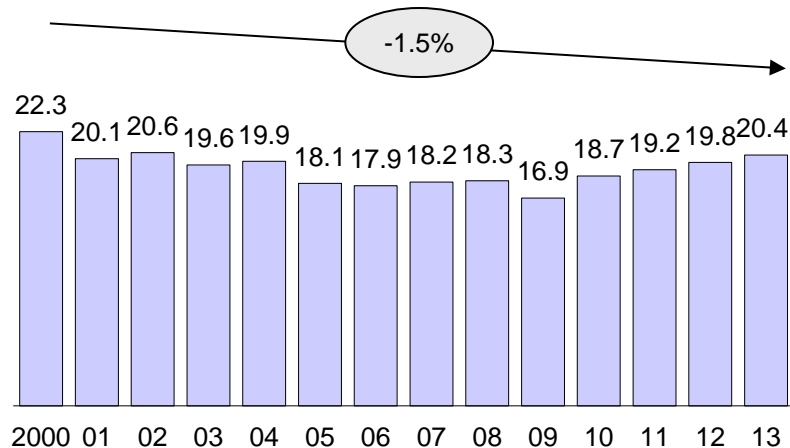
Residential Natural Gas Demand
(Billion Cubic Feet Per Day)



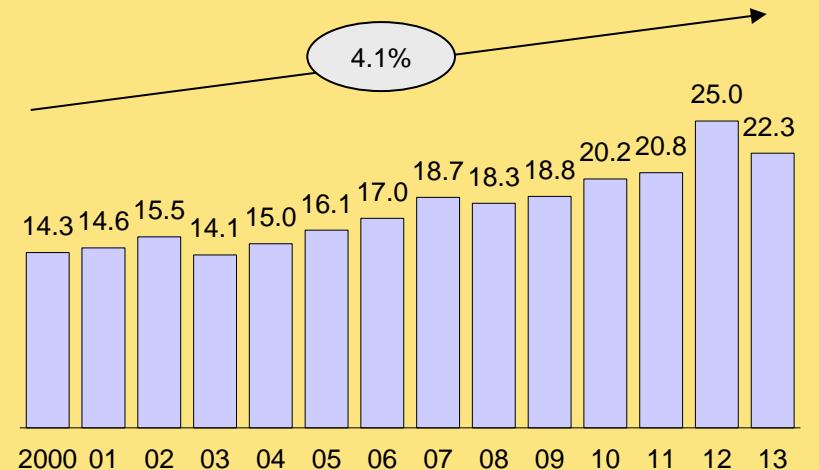
Commercial Natural Gas Demand
(Billion Cubic Feet Per Day)



Industrial Natural Gas Demand
(Billion Cubic Feet Per Day)

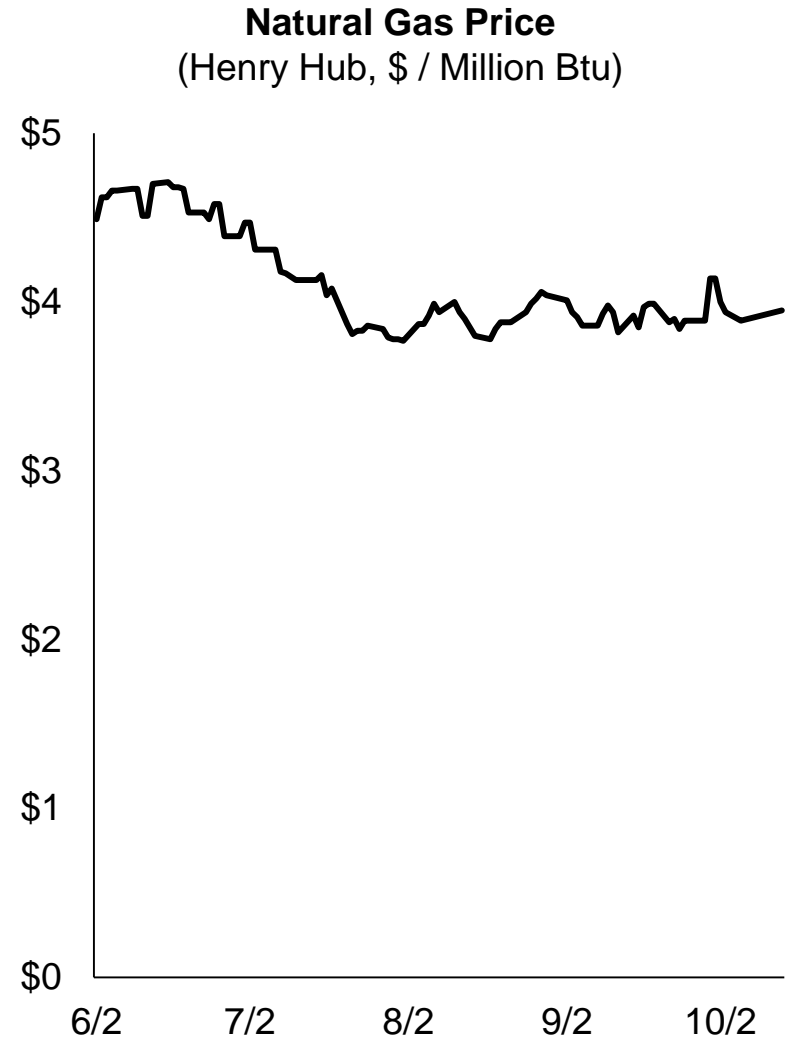
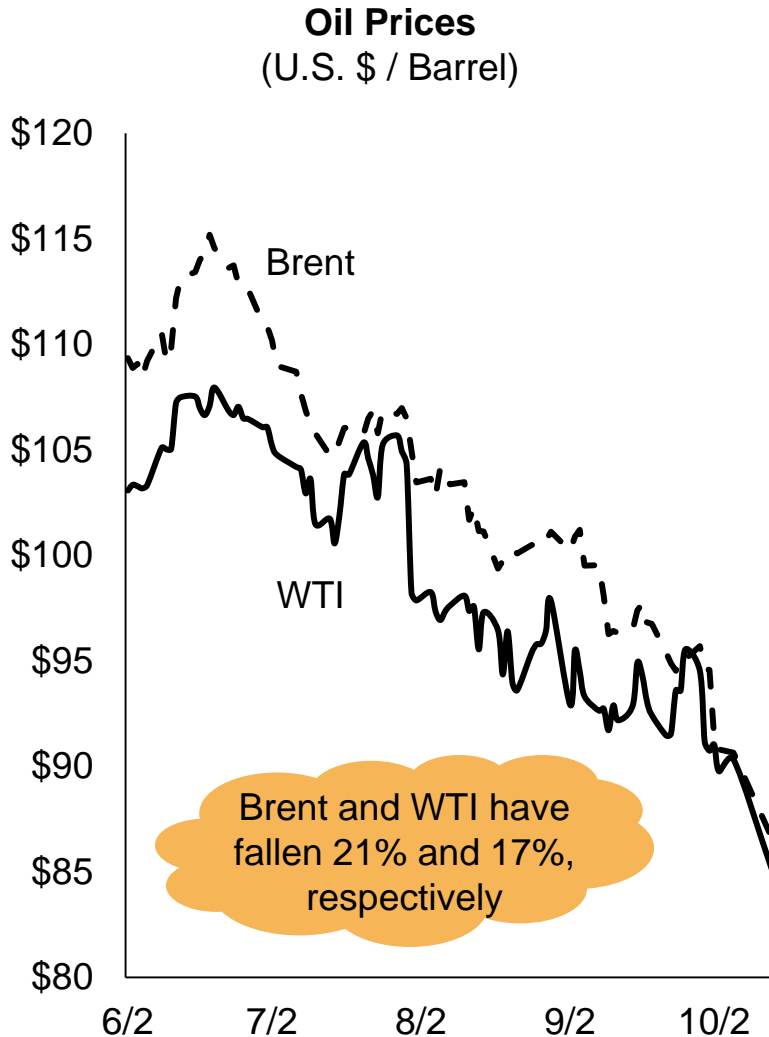


Natural Gas Demand for Power
(Billion Cubic Feet Per Day)



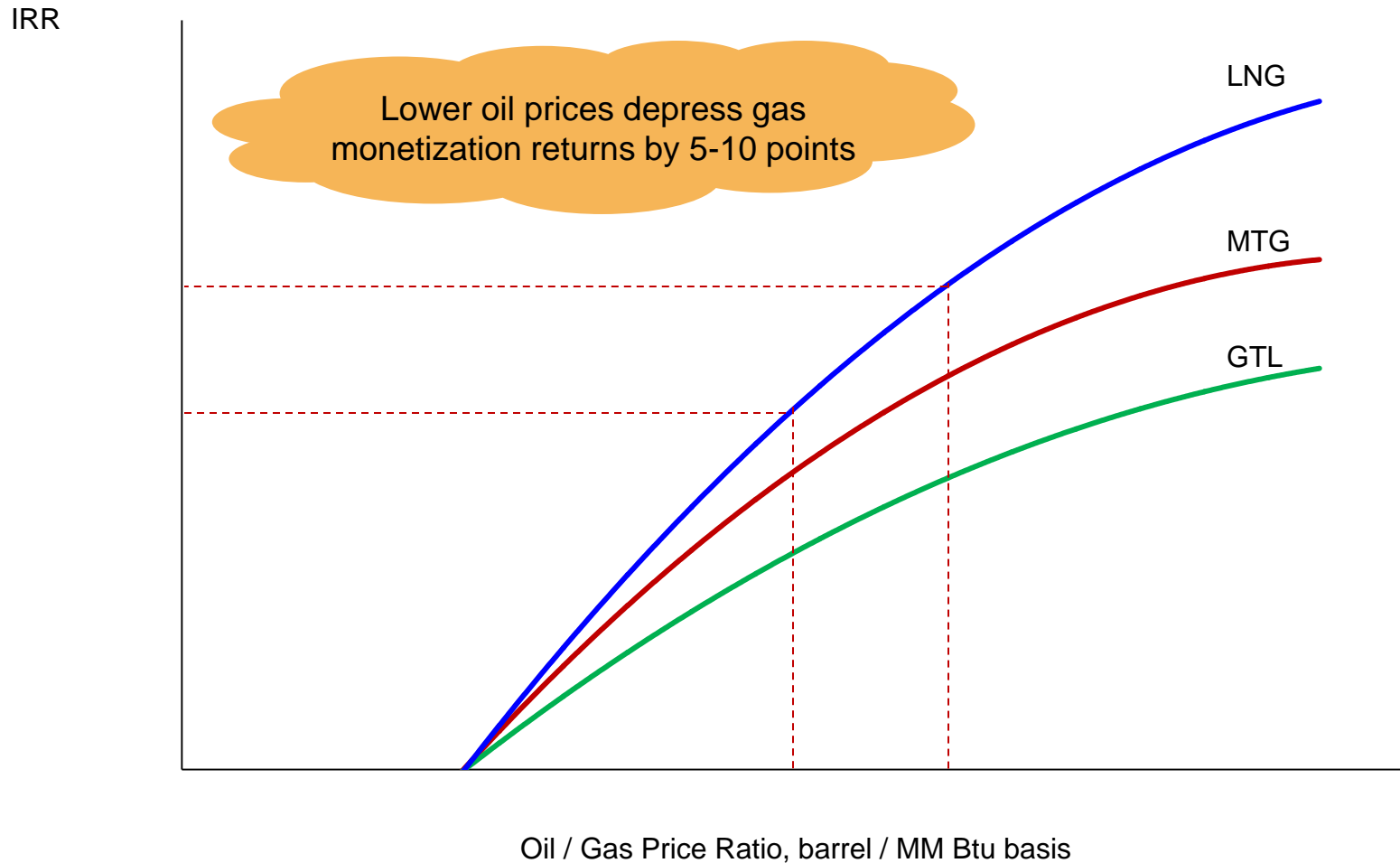
Source: EIA Annual Energy Outlook, 2013

Oil prices have fallen ~20% in the past four months ...



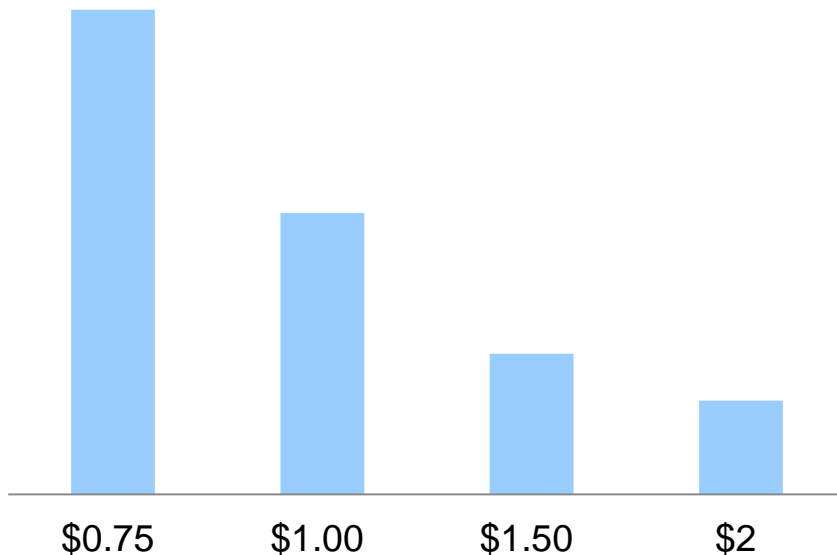
... Posing a significant and material threat to various natural gas utilization projects

Gas Monetization IRRs Vs. Oil/Gas Price Ratio
(U.S. Gulf Coast, 35% Taxes, No Debt)

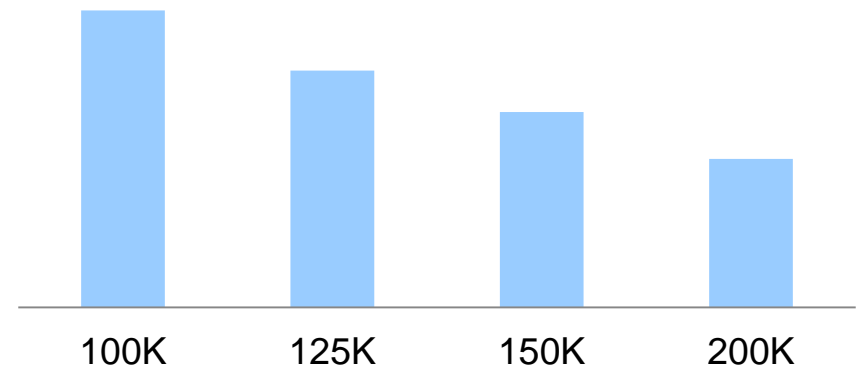


The payback for line-haul LNG truck fleets is 2-3 years based on current commodity prices and typical mileage

Fuel price differential and payback
(Annual mileage fixed at 125K)



Annual mileage and payback
(Fuel price differential fixed at \$1.10)



Base Case Model Assumptions:

1. Diesel price \$4/gal growing at 2% annually, LNG at \$2.9/DGE growing at 0.5%
2. Truck fuel economy of 6.5 mpg diesel; 10% fuel economy penalty for NG engine
3. LNG truck upcharge of \$35,000 for 11.9 L spark ignited NG engine & fuel system
4. 10 truck fleet, annual truck mileage of 125,000
5. Expiring fiscal and tax incentives not included

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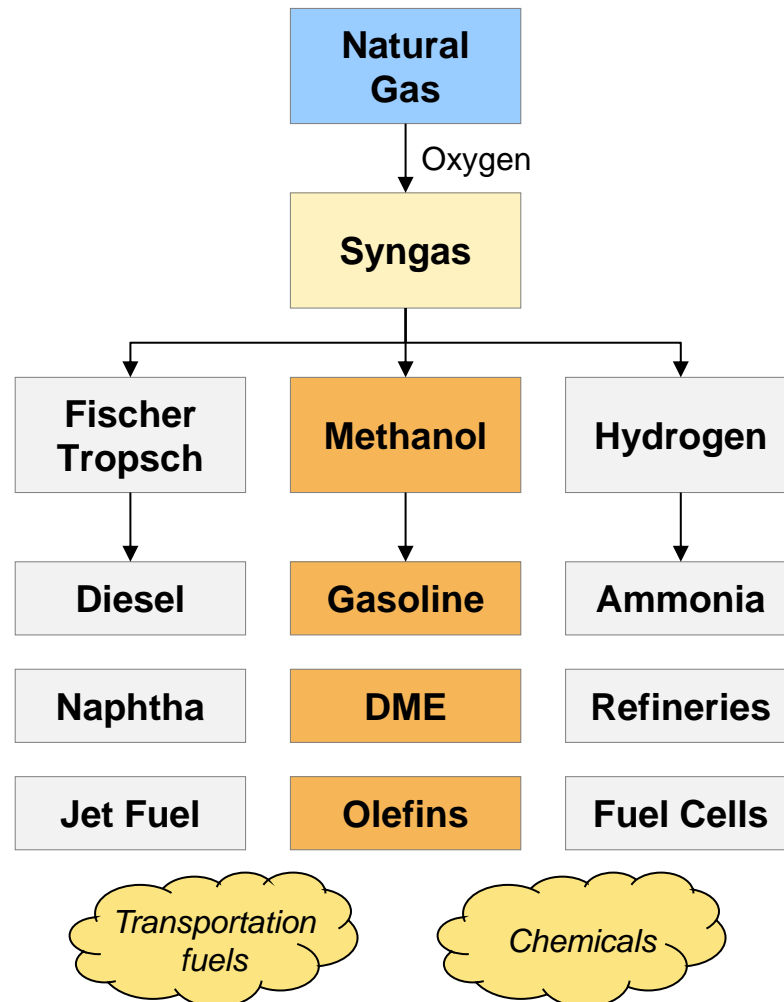
- ▶ About ADI Analytics
- ▶ Gas Utilization and Low Oil Prices
- ▶ **Small-Scale Methanol Technologies**

Key messages

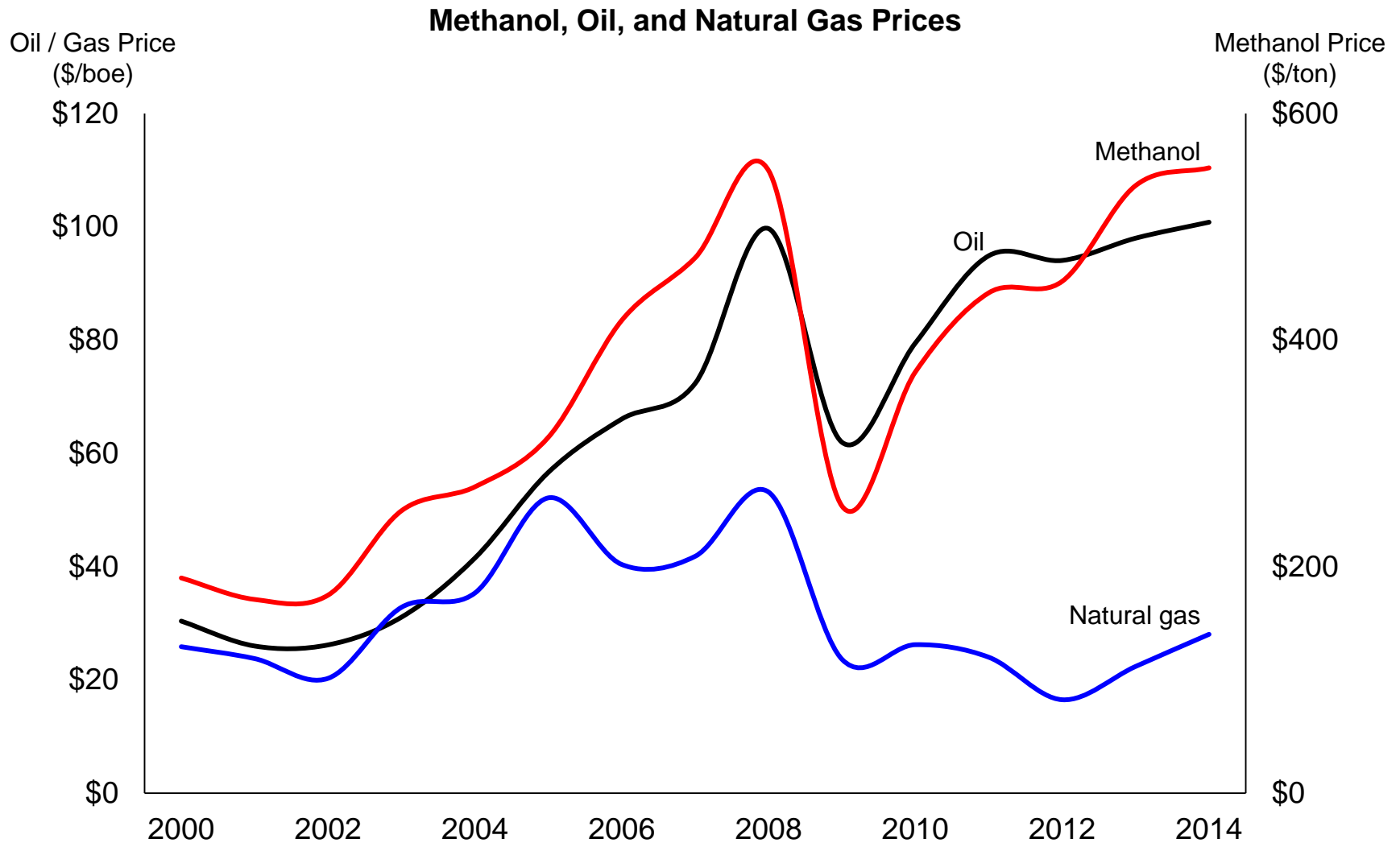
- 1 Natural gas conversion to methanol is a significant opportunity given current commodity prices and that large-scale conversion is a mature process

Natural gas conversion to methanol in large-scale plants is a mature and widely-used process around the world

Natural Gas Conversion Processes



Conversion of natural gas to methanol could be attractive in North America since methanol prices track oil prices



Key messages

1 Natural gas conversion to methanol is a significant opportunity given current commodity prices and that large-scale conversion is a mature process

2 Companies are responding with several large-scale methanol plant announcements in North America many of which will export all their product to Asia

This robust growth outlook coupled with low natural gas prices are driving new methanol projects in North America

List of Methanol Plant Announcements

Company	Location	Start-up	Cost, \$B
Zero Emission Energy Plants	La Place, LA	2106	1.00
Celanese Corp.	Clear Lake, TX	2015	0.79
Valero Energy Corp.	St. Charles, LA	2016	0.70
Methanex Corp.	Geismar, LA	2014/15	1.10
LyondellBasell	Channelview, TX	2014	0.45
G2X Energy	Pampa, TX	2014	0.04
NW Innovations	Kalama, WA / Westward, OR	2018	2.00

List of MTG and DME Plant Announcements

Company	Location	Start-up	Cost, \$B
Emberclear Corp. (MTG)	Natchez, MS	2019	2.80
G2X Energy (MTG)	Lakes Charles, LA	2017	1.30
OCI Partners LP (MTG)	Beaumont, TX	2016	1.00
Sundrop Fuels Inc. (MTG)	Colorado	2014	0.58
Marcellus GTL LLC (MTG)	Allegheny/Blair Townships, PA	2015	0.25
SoCalGas Co. (DME)	Southern California	2014	0.05

Key messages

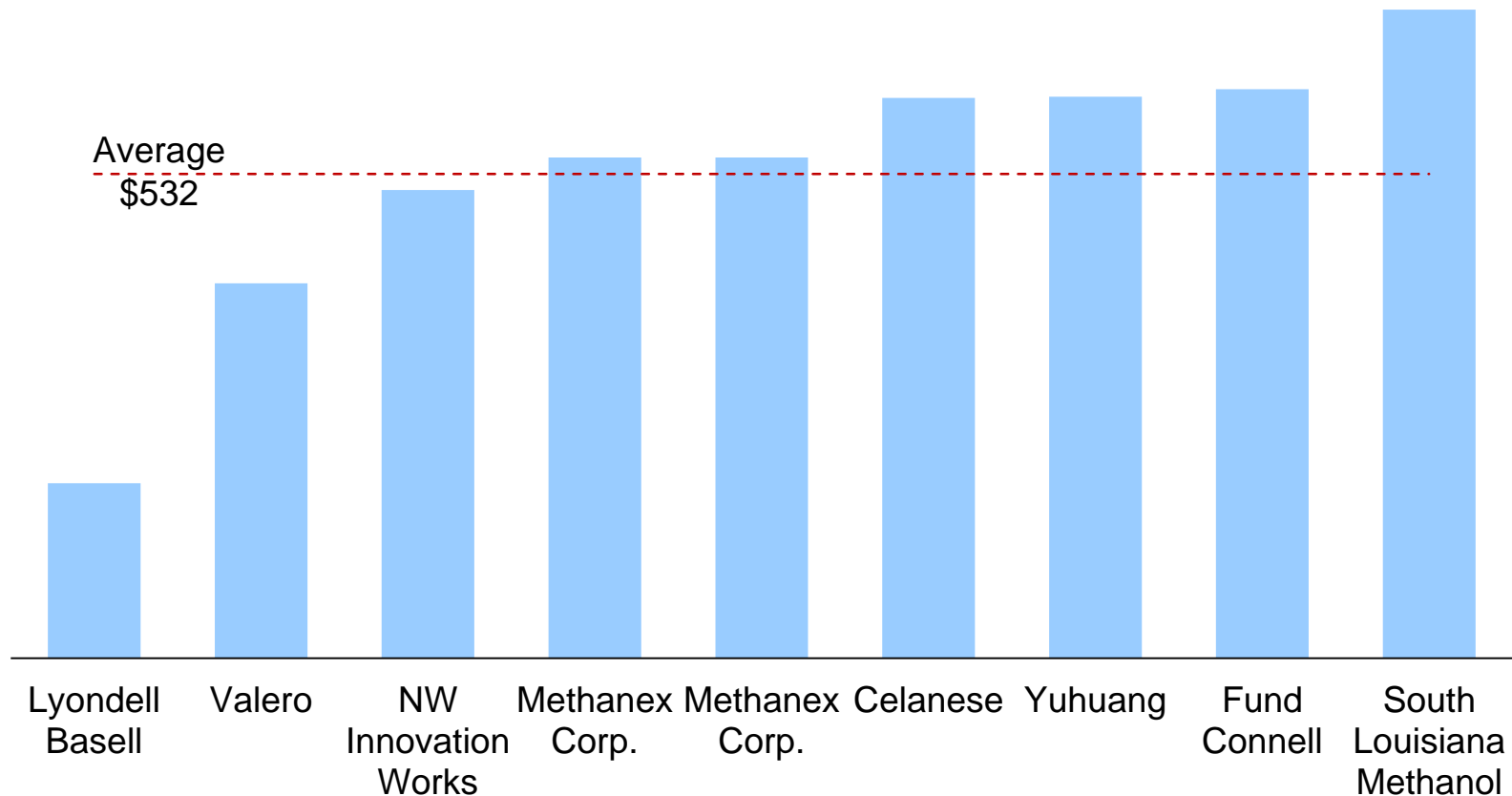
1 Natural gas conversion to methanol is a significant opportunity given current commodity prices and that large-scale conversion is a mature process

2 Companies are responding with several large-scale methanol plant announcements in North America many of which will export all their product to Asia

3 Small-scale methanol plants have higher capital costs but can be economically viable in the Marcellus if they can source natural gas at attractive prices

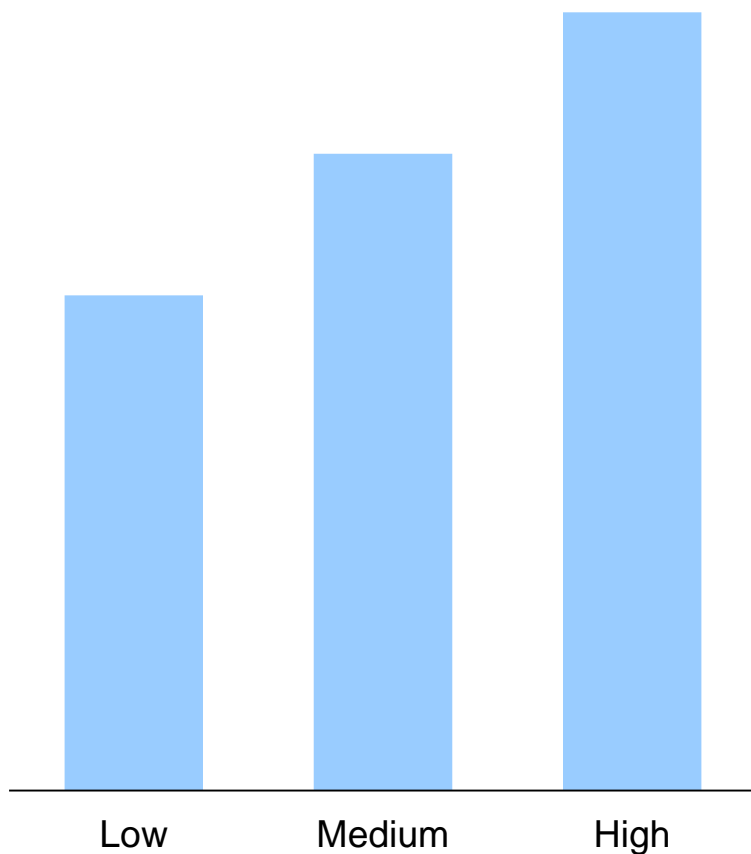
In recent years, methanol plants have grown in size enabling economies of scale and low capital costs

Estimated Capital Costs for Planned Methanol Plants in U.S.
(U.S. Dollar Per Ton Per Year of Capacity)

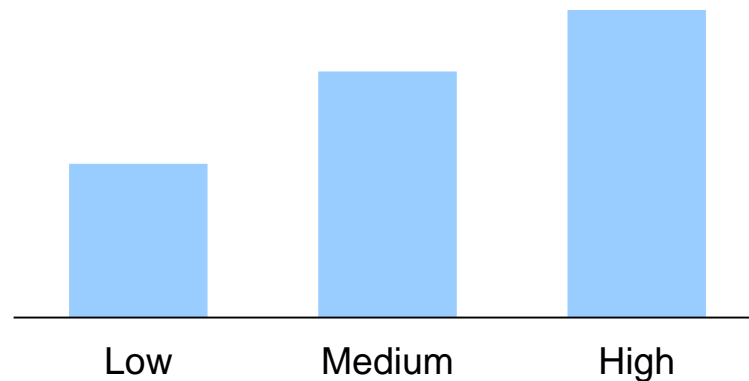


In comparison, small-scale units will have higher capex per ton of production but could benefit from cheap feedstock gas

Capital Cost for Small-Scale Methanol Plants
(U.S. Dollar Per Ton Per Year of Capacity)



Natural Gas Feed Cost
(U.S. Dollar Per Million Btu)

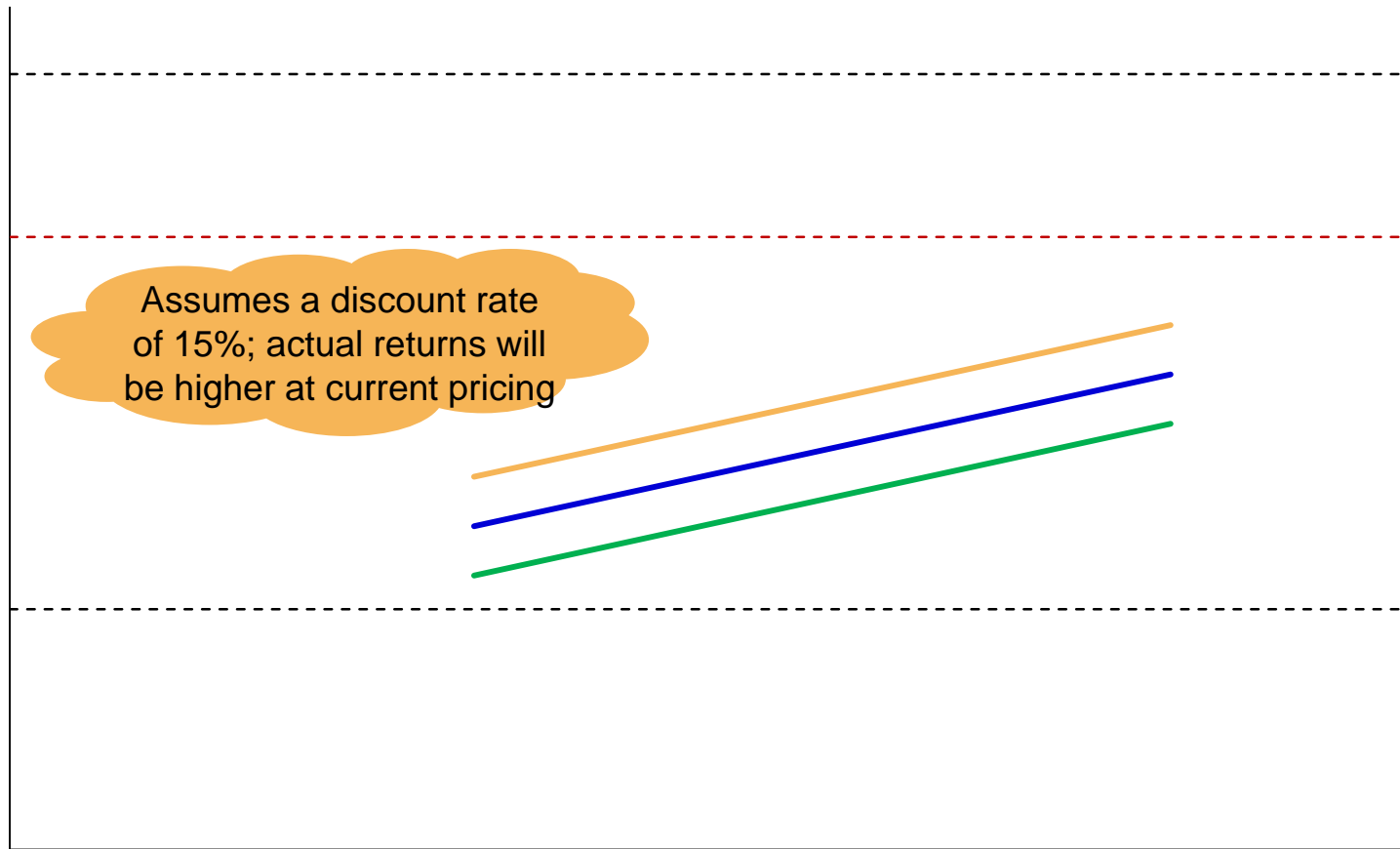


Other assumptions

Capacity, tons per day	50
Gas per ton of methanol, MM Btu	36
Plant life, years	20
Interest rate, percent	15%
Operational cost, percent of capex	10%

In sum, methanol from small-scale plants could be produced at a cost significantly lower than current or historical pricing

Cash Cost of Methanol from Small-Scale Plants
(U.S. Dollar Per Ton)



Natural Gas Cost, \$ / MM Btu

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4 Investors will have to address technology risk associated with small-scale methanol plants and lower regional demand

Few companies are developing small-scale methanol technology which needs to be demonstrated commercially

Maverick Synfuels

- Offers small-scale, skid-mounted, modular, 10-30 tons/day methanol plants using commercial steam methane reforming and methanol synthesis catalysts
- Claims a novel engineering design with small footprint and short delivery time
- Process tested at a pilot / demonstration scale but not commercialized yet
- Announced JV for a plant in Canada and partnership with a fabricator for plants

R3 Sciences

- Developing a homogeneous catalyst-based 3-30 tons/day methanol plants
- Claims process operates at a lower temperature and pressure with higher syngas conversion per pass and selectivity to methanol leading to lower capex
- Plans to transition process through pilot / demonstration scales in 2014-15 with a commercial unit targeted by the end of 2015

Oberon Fuels

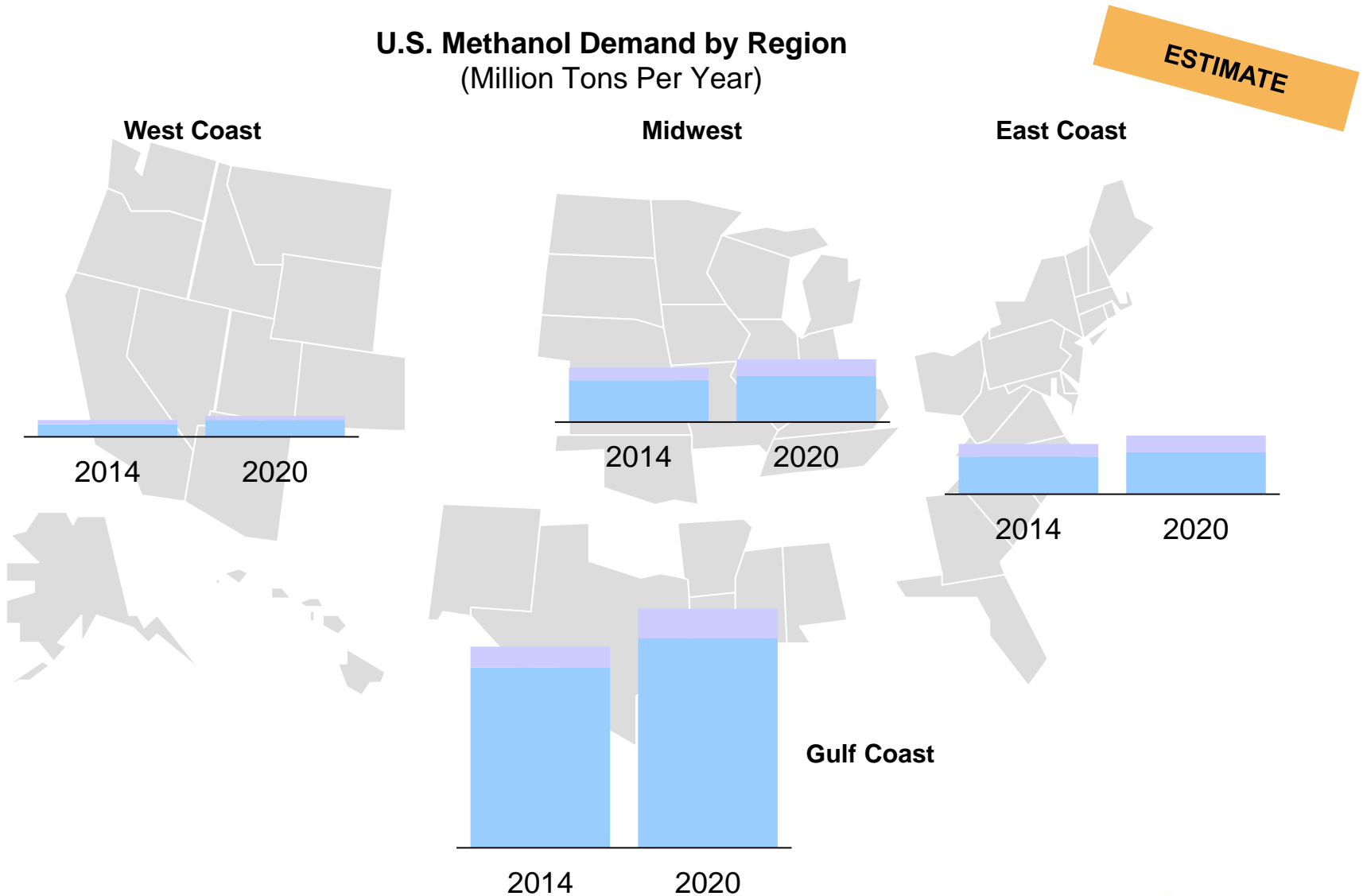
- Developed proprietary skid-mounted, small-scale production units to convert methane and carbon dioxide to DME and methanol at 10-30 ton/day capacity
- Focusing development and commercialization effort on DME than methanol

GasTechno GTL

- Developing direct conversion process for gas to methanol and other products
- Process tested at pilot-scale and now targeting demonstration scale
- Claims ability to handle rich gas streams with limited pre-treatment and ...
- ... A wide range of scales from 1 to ~450 tons per day of products
- Company estimates capital costs of \$400-\$1,350 for 17-55 tpd plants

Finally, regional methanol demand is low although new NGL crackers could change this going forward

U.S. Methanol Demand by Region
(Million Tons Per Year)



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