Perspectives on Domestic Natural Gas Supplies and Productive Capacity

Prepared for:
Workshop: "Growing the North American Natural Gas Production Platform"
Strategies for Addressing Infrastructure Constraints, Regulatory Risks and Trade Disputes

Hosted by:
EPRINC

Prepared By:
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Willard Hotel, Washington, DC
April 19, 2018

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Introduction

The U.S. has large natural gas resources that have low-to-moderate "break-even" costs.* These resources include:

- Over 2,700 Tcf of proved plus technically recoverable unconventional gas resources (shale gas, tight gas and CBM), including significant volumes of associated gas from "tight oil".
- Over 400 Tcf of remaining on-shore (L-48) conventional gas reserves and resources, with much of this resource located in smaller, higher-cost-to-develop fields.
- Nearly 200 Tcf of associated gas reserves and resources in deepwater Gulf of Mexico oil fields, with additional reserves and resources in Alaska.

With continuing gains in well performance and the "discovery" of new shale and "tight oil" plays, our understanding of the size of the ultimate U.S. natural gas resource base has increased steadily in the past two decades and will continue to do so in the future.

*We define "break-even" costs as full-cycle finding and development costs with a 15% (before tax) return on investment.

Status of U.S. Natural Gas Production

After declining to 72 Bcfd (dry) in 2016, natural gas production increased to 74 Bcfd in 2017. With a 4Q 2017 natural gas production rate of 76 Bcfd (dry), we look for natural gas production to have a second year of strong growth, averaging 80 Bcfd in 2018. Shale gas increases its role as the dominant source of natural gas production and growth.

U.S. Natural Gas Production (Dry)

	2016	2017	2018 (e)
	(Bcfd)	(Bcfd)	(Bcfd)
Unconventional Gas			
▪ **Shale Gas**	42	45	52
▪ **Tight Gas**	15	14	13
▪ **CBM**	3	3	3
Total	**60**	**62**	**68**
Conventional Gas*	12	12	12
Total	**72**	**74**	**80**

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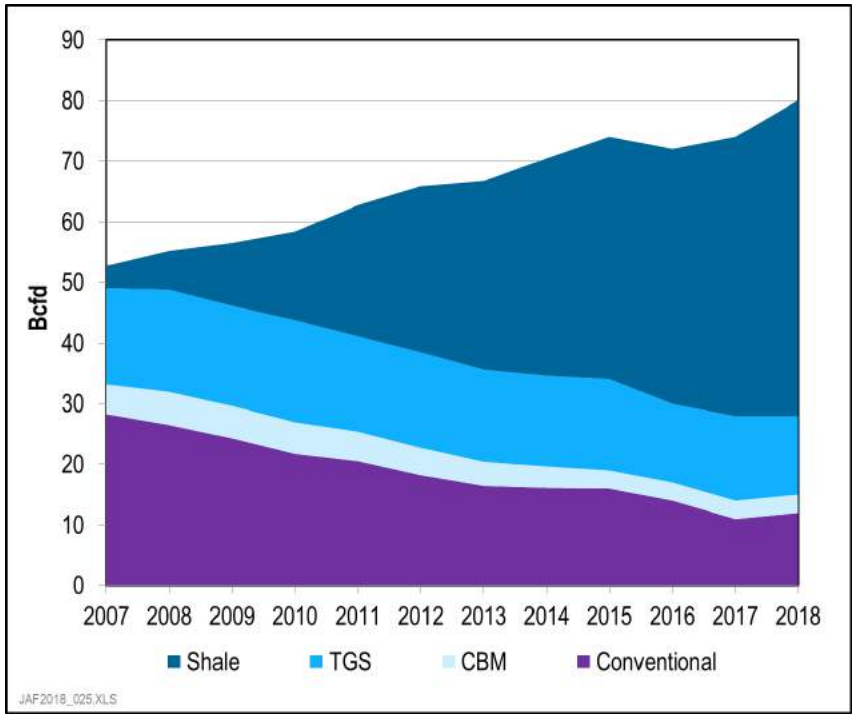
*Includes L-48 onshore, offshore and Alaska.
Source: EIA; Advanced Resources Int. Shale Gas Database, 2014.

U.S. Natural Gas Production (Dry)



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Outlook for U.S. Natural Gas Production

Led by significant increases from shales and associated gas from "tight oil", we project domestic natural gas will reach 100 Bcfd of "production capacity" by 2025.

- Production from Appalachian Basin's Marcellus and Utica Shales, currently at 26 Bcfd, will provide about a third of total natural gas production by 2025.
- Associated gas from "tight oil" (including shale oil and tight sands oil), currently at 17 Bcfd, will provide about a quarter of total natural gas production by 2025.
- Production from the Haynesville Shale, after halting its past spectacular decline, is on the rise and is expected to be a major supply source for the next round of LNG plants.
- Emerging shale and tight gas plays, such as the Anadarko Basin's Stack/Scoop and the DJ Basin's sands and shales, will more then counter declines in the pioneering Antrim, Barnett, and Fayetteville shales.
- Active development of already discovered deepwater oil fields along with new discoveries will enable the Offshore Gulf of Mexico grow its associated gas production.

Changes in Rig Counts Help Identify Growing Shale/Associated Gas Basins

Active Rig Count: Selected Basins

Selected Basins/ Plays	End of 2016	End of 2017	April 2018
1. Associated Gas			
Permian	264	398	445
Eagle Ford	46	70	75
Williston	33	47	55
Cana Woodford*	37	72	65
D-J Niobrara	25	26	24
Total	**405**	**613**	**664**
2. Shale Gas			
Marcellus	39	48	55
Haynesville	27	46	52
Utica	20	28	25
Other**	27	30	27
Total	**113**	**152**	**159**

*Does not include Kingfisher Co., Oklahoma.
**Includes Barnett (3), Fayetteville (1), Ardmore/Arkoma (9), Miss Lime (2) and Granite Wash (12) in April, 2018.

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Associated Gas. Rig utilization in five key "tight oil" plays (containing associated gas) has climbed from 613 at the end of 2017 to 664 today. The Permian with an increase of 47 rigs account for most of the gain.

Shale Gas. Rig utilization in other shale gas plays has rebounded from 152 at end of 2017 to 159 today. The Marcellus and Haynesville account for two-thirds of the shale gas rig fleet.

Appalachian Basin's Shale Gas Production Surges

The Appalachian Basin has some of the lowest cost (at the wellhead) domestic shale gas resources.

Completion of Rover Phase I, the Leach Express, and the Access pipelines (among others) enabled natural gas production and delivery from the Appalachian Basin to increase by 2 Bcfd in 2017. Completion of additional pipelines (Rover Phase 2, SW Louisiana, and others) will support 3 Bcfd of natural gas production growth from Appalachian Basin in 2018.

However, access to regional markets and need to complete long distance pipelines to the Gulf will constrain near-term production.

Appalachian Basin's Shale Gas Production (Dry)

Shale Play	2016 (Bcfd)	2017 (Bcfd)	2018 (Bcfd)
Marcellus	16.4	17.7	20.0
Utica	3.8	4.5	5.5
Other	0.4	0.5	0.5
Total	**20.6**	**22.7**	**26.0**

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Associated Gas from "Tight Oil"

Associated gas from "tight oil" - - the Bakken, Eagle Ford, Permian Stack/ Scoop, Denver's Niobrara (among others) - - has provided about half of the recent increases in natural gas supplies.

"Tight Oil" Play	Associated Gas Production (Dry) (Bcfd)		
	2016	2017	2018
Bakken	1.1	1.2	1.3
Eagle Ford*	4.0	3.5	3.5
Permian (TX / NM)	3.4	4.2	6.0
Anadarko	2.3	2.5	3.3
Denver	1.3	1.7	2.2
Other	0.7	0.9	0.9
Total	12.8	14.0	17.2
Subtotal Shale	9.3	10.5	13.6

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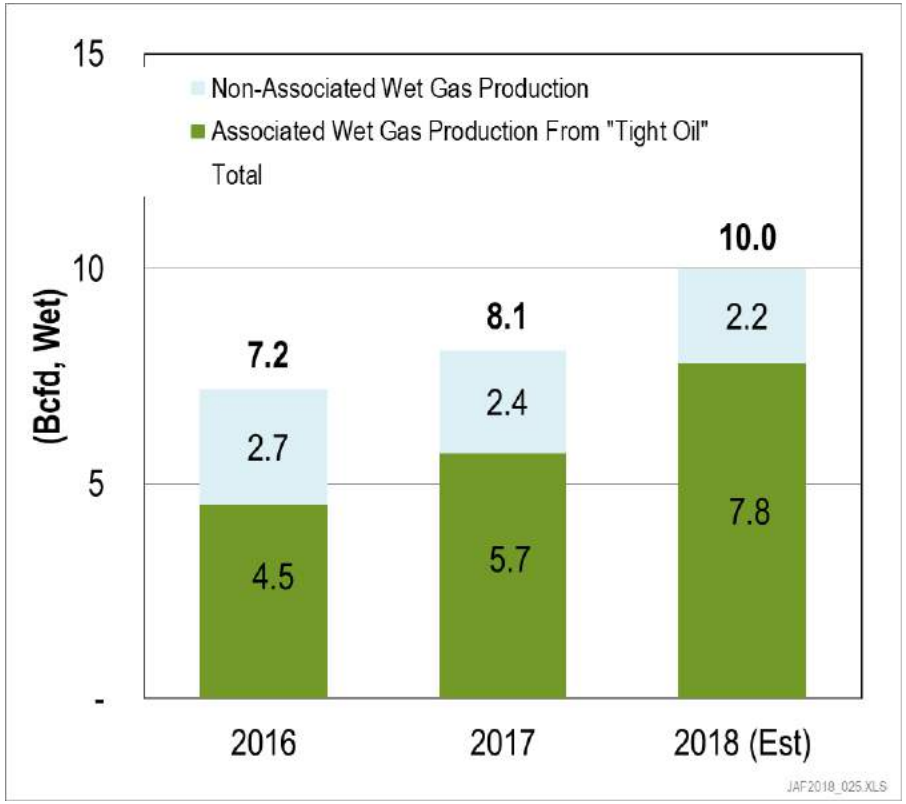
*The Eagle Ford Shale and the STACK/SCOOP also contains non-associated gas plays not dependent on "tight oil" development or economics.

- With higher oil prices, associated gas production from "tight oil" increased notably in 2017 and will increase further in 2018.
- Because associated gas from "tight oil" is a by-product of oil production, at strong oil prices production of associated gas becomes essentially a "free good."

Growth of Permian Basin's Wet Natural Gas Production

Natural gas production from the Permian Basin provided 8.1 Bcfd (wet) of natural gas production in 2017, up from 2016. We project the Permian will provide 10 Bcfd in 2018.



- Associated gas (wet) from "tight oil" of 5.7 Bcfd in 2017, increasing to 7.8 Bcfd in 2018, is the engine of production growth in the Permian Basin.*
- The "discovery" of "Alpine High" in the Delaware Basin portion of the Permian Basin introduces a major new wet gas play.

*Dry associated natural gas production from "tight oil" would be approximately 25% lower, estimated at 4.2 Bcfd in 2017 and 6.0 Bcfd in 2018.

Outlook for Future Shale Gas "Break-Even" Costs

A major question governing the outlook for natural gas production is: *To what extent will future natural gas "break-even" costs encourage or stymie gas demand and competitively priced LNG exports?*

Improvements in well productivities and development efficiencies have reduced today's "break-even" costs for shale gas.

Will more intensive well completion practices (longer laterals, more frac stages, and higher proppant volumes) improve well productivity sufficiently to counter increases in oil field service costs?

To examine this question, we selected the "core" area of the Haynesville Shale to look at future "break-even" costs.

Haynesville Shale Core Area "Break-Even" Costs

	Actual 2017 (@ $50/B)	Projected 2025 (@$65/B)
Lateral Length	**7,400**	**8,500**
1. Well Drilling		
Days to Drill	30	21
Rig Day-Rate ($/day)	$15,000	$23,000
Total Well Drilling Costs ($M)	**$3,400**	**$3,710**
2. Well Completion		
Frac Stages	25	33
Frac Cost ($/Stage)	$60,000	$79,000
Total Completion Costs ($000)	**$5,100**	**$6,430**
Total Well D&C Cost ($000)	**$8,500**	**$10,140**
Gross EUR/Well (Bcf)	**18.4**	**21.2**
"Break-Even" Costs ($/Net Mcf)	**$2.50**	**$2.60**

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Our shale gas model uses well performance and cost adjustment factors to link changes in development practices and oil field service costs to future "break-even" costs.

Use of more frac stages (33), higher proppant volumes (2,500 lbs/ft), and somewhat longer laterals (8,500 ft) will improve Haynesville Shale Play #1's well productivity from 18.4 Bcf in 2017 to 21.2 Bcf in 2025.

Improving well performance and greater drilling efficiencies will help counter increases in service costs as well as the costs of more intensive development, limiting Year 2025 "break-even" costs to $2.60/Mcf compared to $2.50/Mcf in 2017.

Closing Comments

The domestic natural gas resource base is large and yet to be fully defined.

Increases in well productivities and development efficiencies will counter increases in oil field service costs, helping maintain domestic natural gas as a low-to-moderate cost resource.

Canadian natural gas resources, led by the Montney Resource Play (Canada's Marcellus), further support a positive outlook for North American natural gas supplies.

With the change in the natural gas paradigm from "scarcity to plenty", the emphasis now shifts to "productive capacity" and the need for transportation infrastructure and new markets.

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Permian Basin Production and Looming Issues

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FOR THE ENERGY POLICY RESEARCH FOUNDATION., INC.

APRIL 19, 2018

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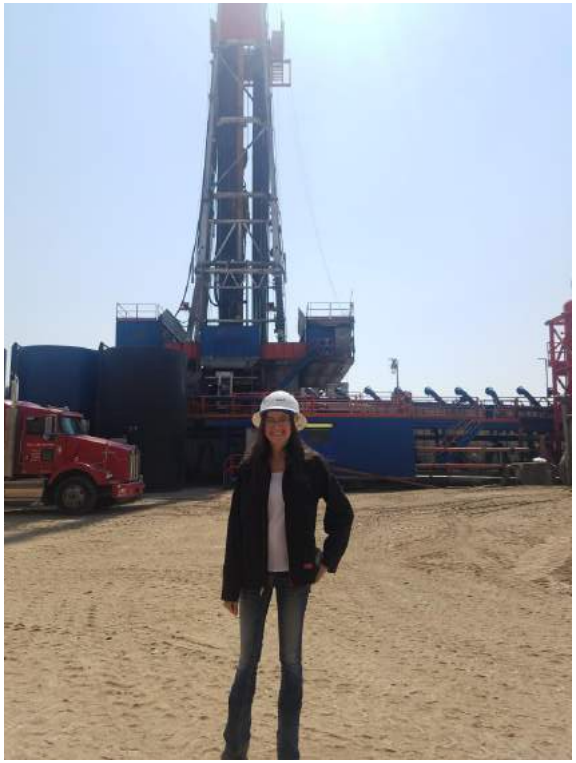

Source: Extraction rig, September 2017

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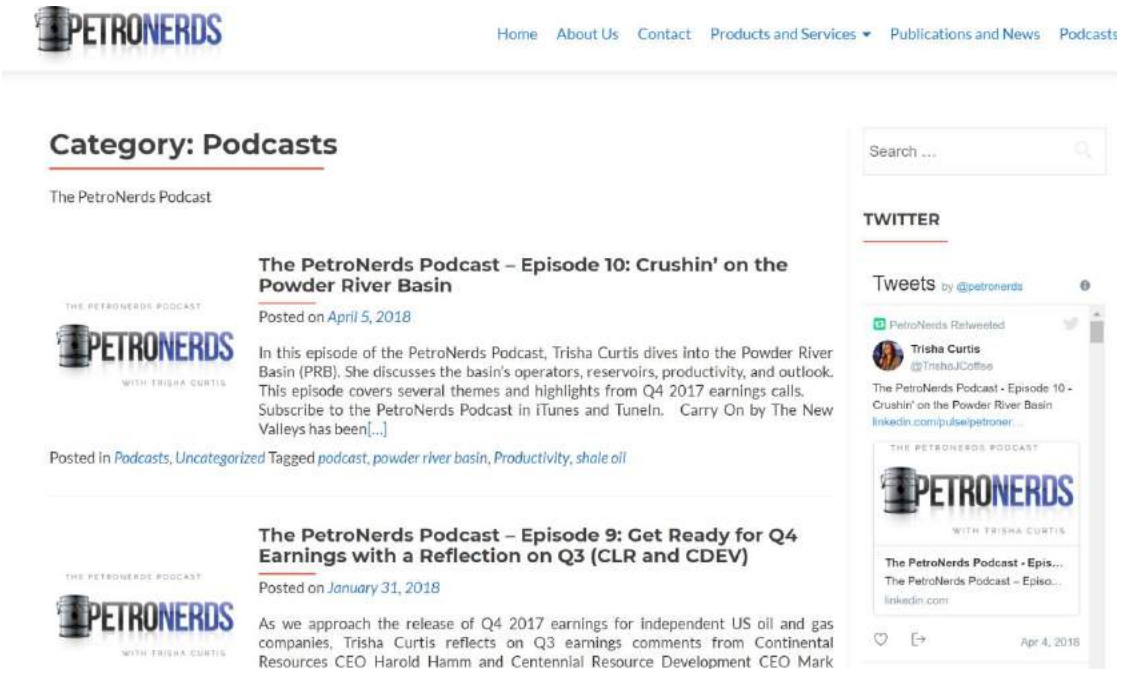
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“Completion Design Changes and the Impact of US Shale Well Productivity”

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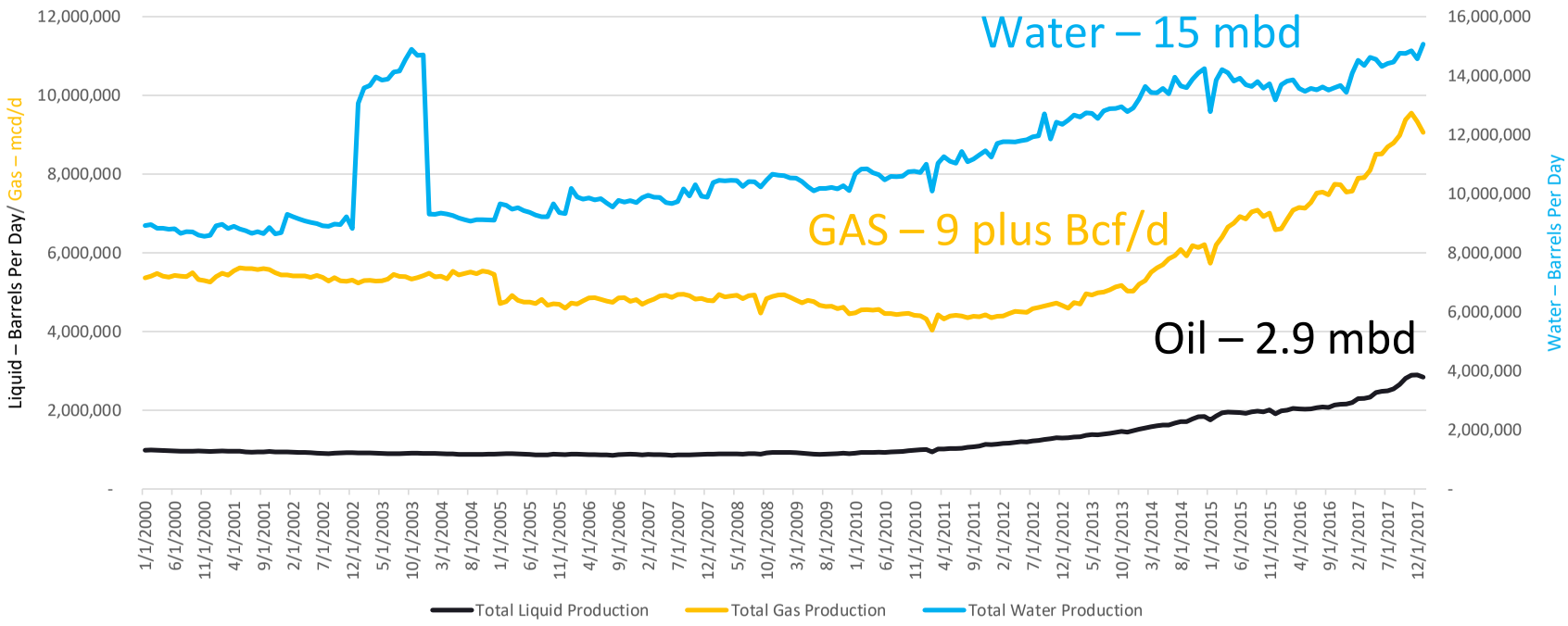
Spud to Total Depth in Less than Three Days

Extraction Oil and Gas, September 2017

Permian Basin Production



Permian Problems

With crude oil comes associated natural gas and produced water

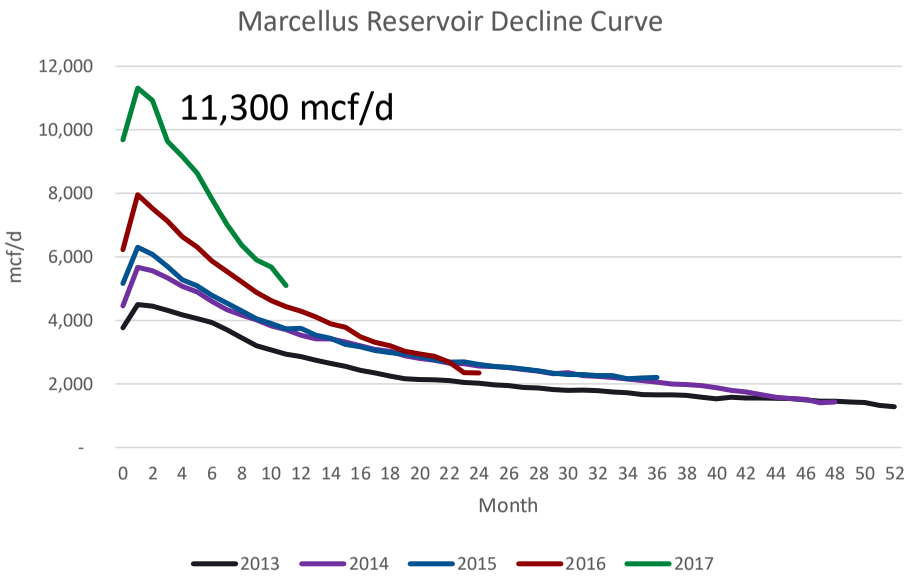
Gassy reservoirs can help drive oil production – at least in the Permian's case.

It isn't just the Permian that is the problem…..gas EVERYWHERE

- Ultra Petroleum – Pinedale, Wyoming

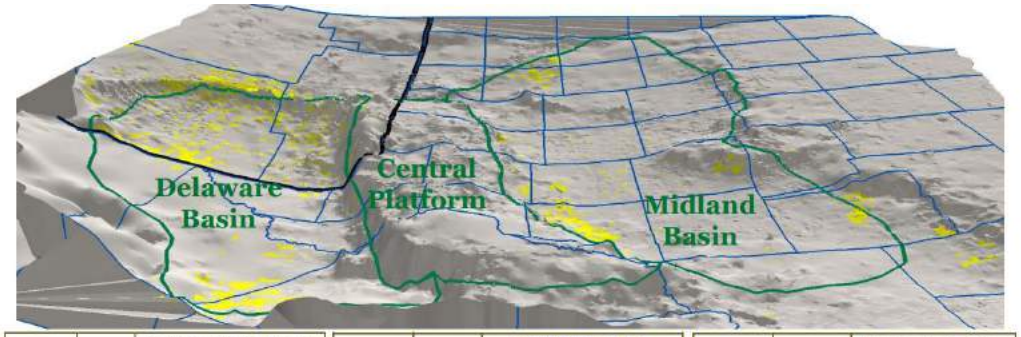
High intensity completions have done wonders for oil production and even more for gas production (IPs and well productivity)

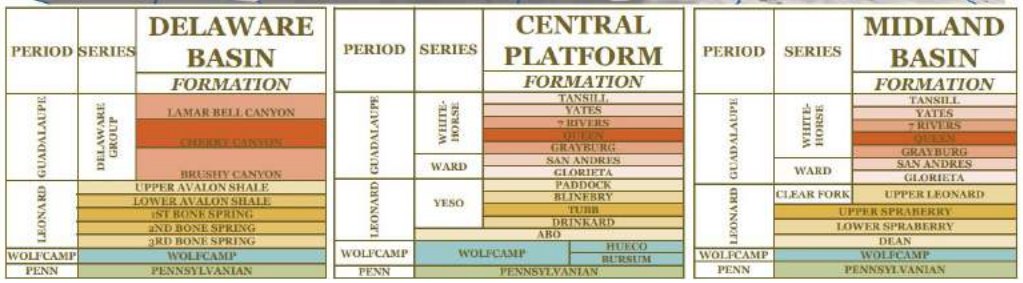
- Marcellus

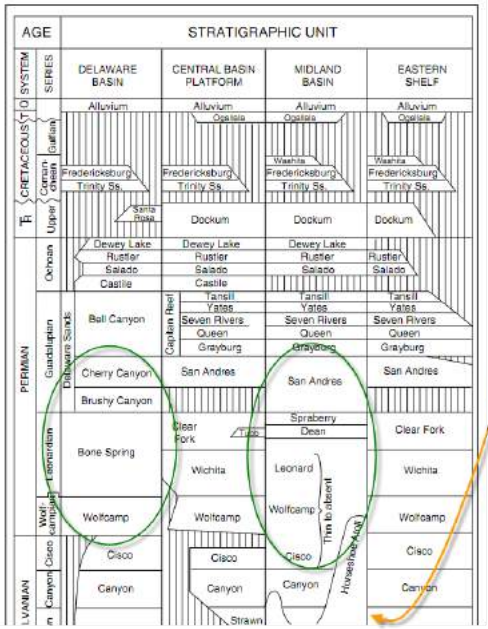


Source: PetroNerds, DrillingInfo data

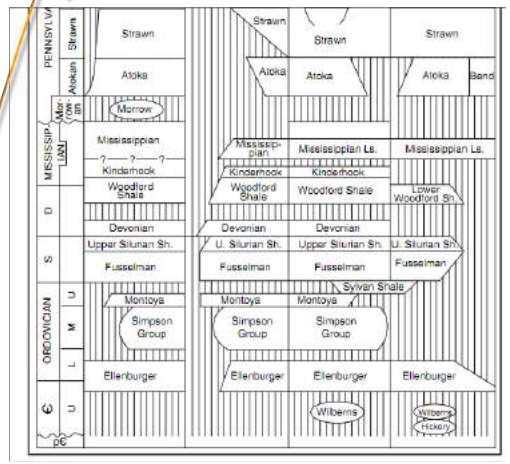
Permian Basin Geology and Stratigraphy







The Permian hosts a vast amount of stacked payzones that are actively being drilled and further delineated for the best spacing and completion plans.



Source: PERMIAN BASIN PROVINCE (044) By Mahlon M. Ball

Source: Concho Resources 2nd Quarter 2013 Investor Presentation

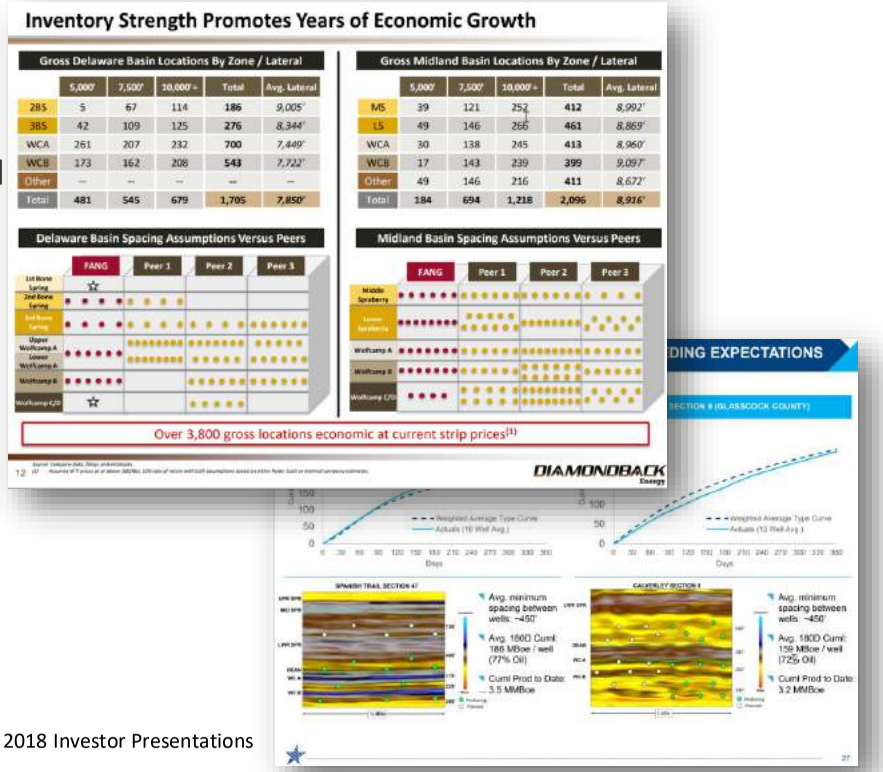
Still Early in the Game

This is a highly layered mix of conventional and unconventional reservoirs.

- Intense layering
- Interbedded shales, sandstones, and carbonates

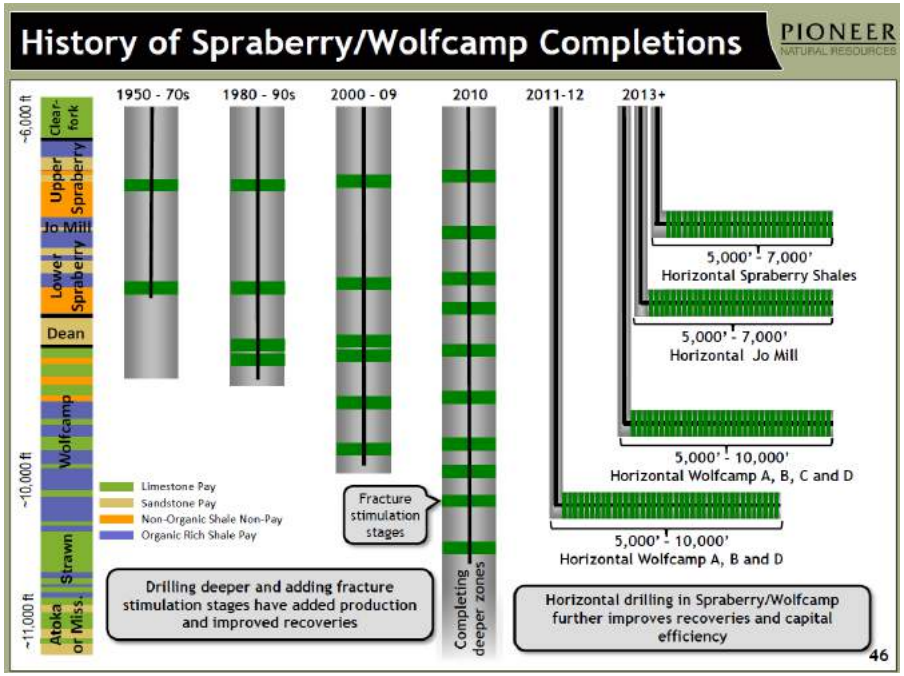
The Permian Basin has a tremendous amount of potential in terms of stacked pay, but successfully developing these stacked payzones will take a lot of work and a lot of capital.

- Stringent leasing requirements in the Permian Basin often prevent optimal asset delineation
- Land rush, Wall Street push, and high acreage costs
  - Now operators are trying to delineate, develop, and maintain leasing requirements all at the same time
  - Cost inflation also causing problems with soo much activity in the Permian
  - Local sand etc.
- Optimal spacing and completion design (frac) is key
  - Still early in this ball game
  - Inventory
  - Well density, parent child problems, all coming into focus

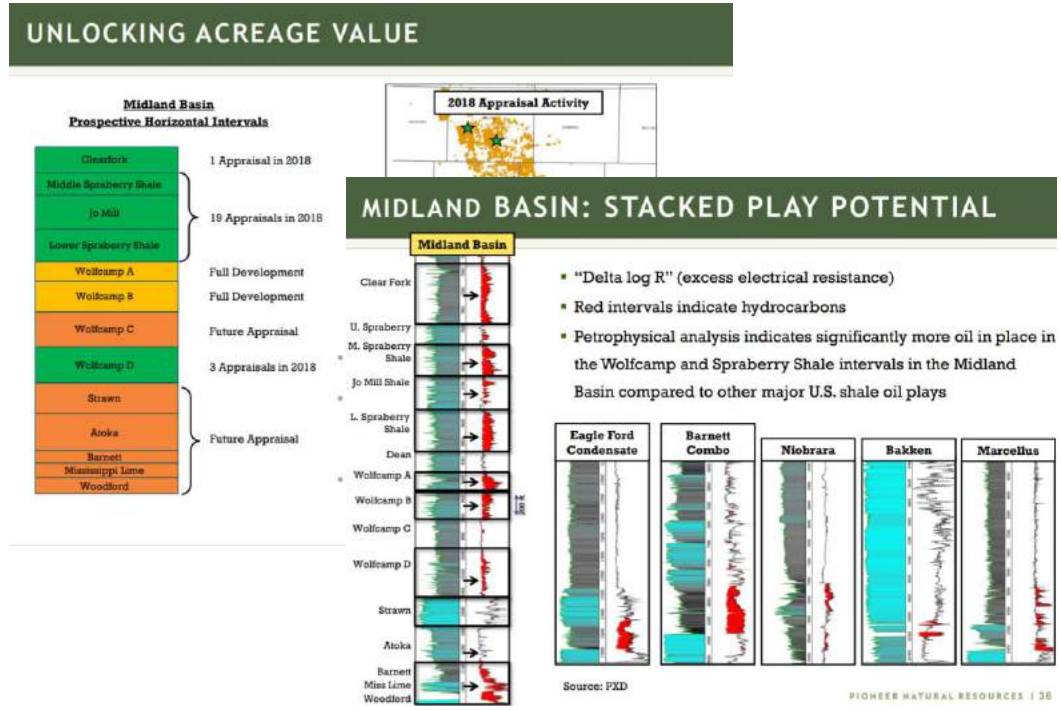


Source: Diamondback and Cimarex April 2018 Investor Presentations

Pioneer – Then and Now

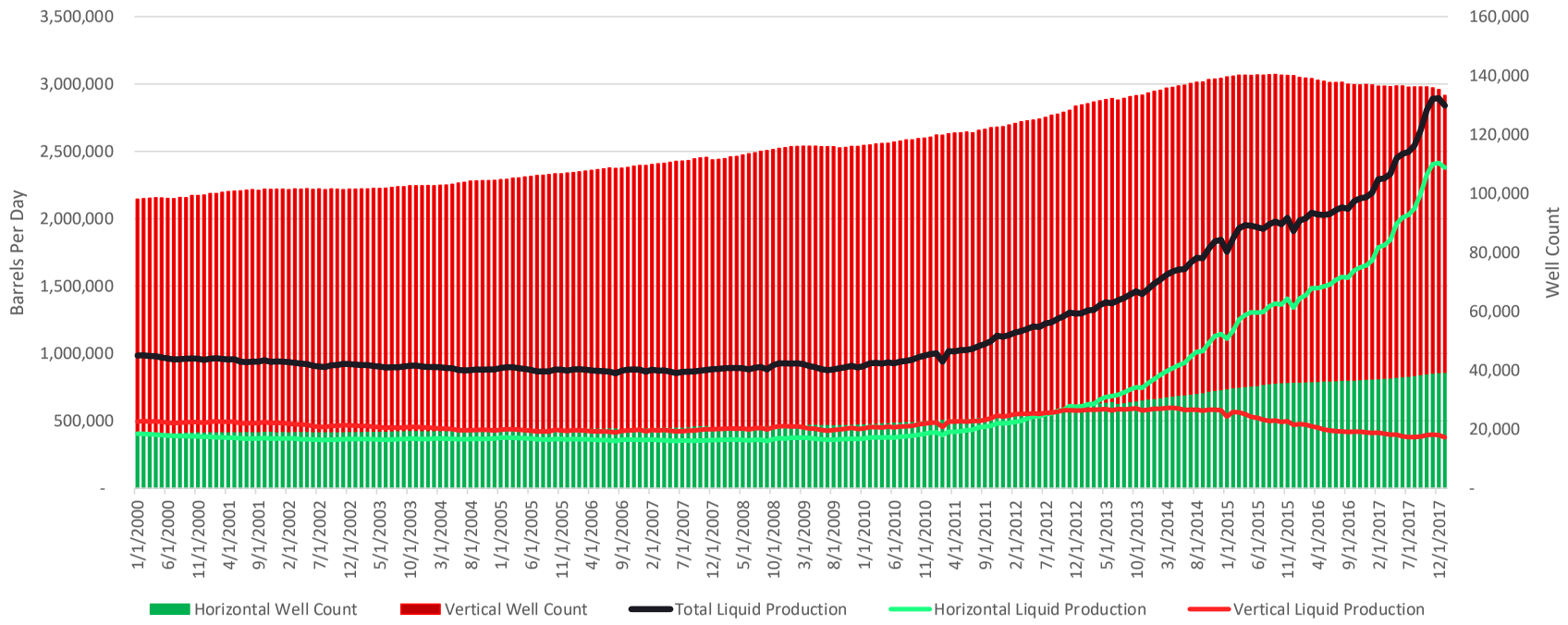


Source: Pioneer Natural Resources Oct 2013 Investor Presentation



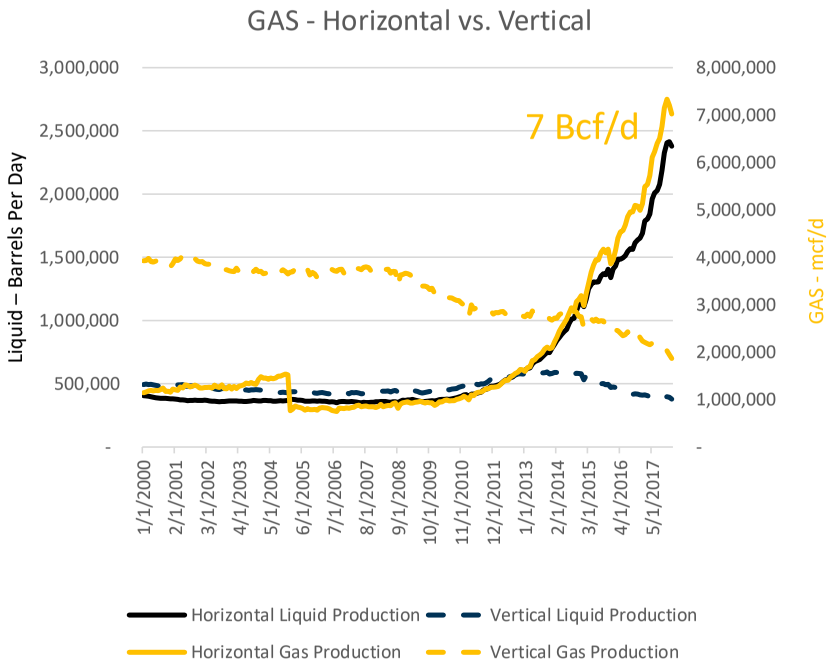
Source: Pioneer Natural Resources April 2018 Investor Presentation

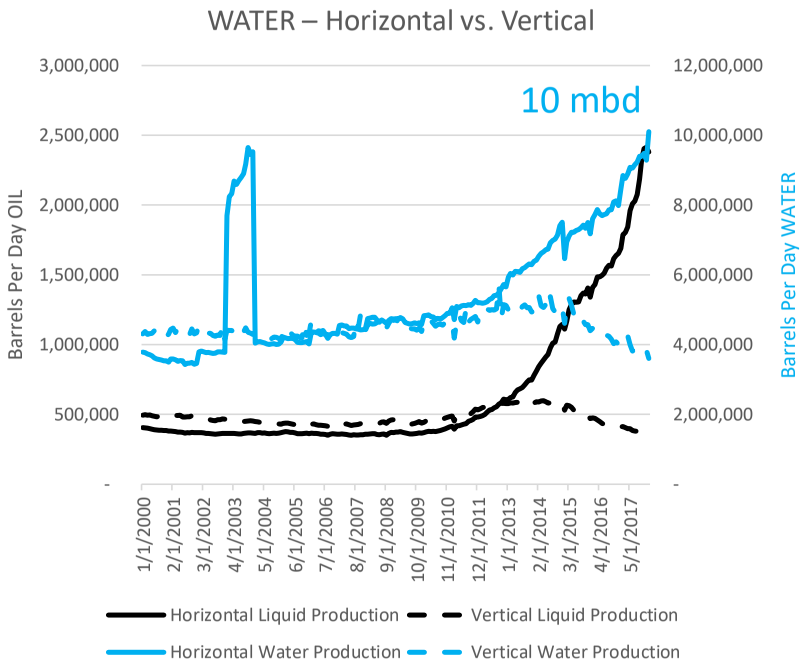
Horizontal Liquid Production



Source: PetroNerds, DrillingInfo data

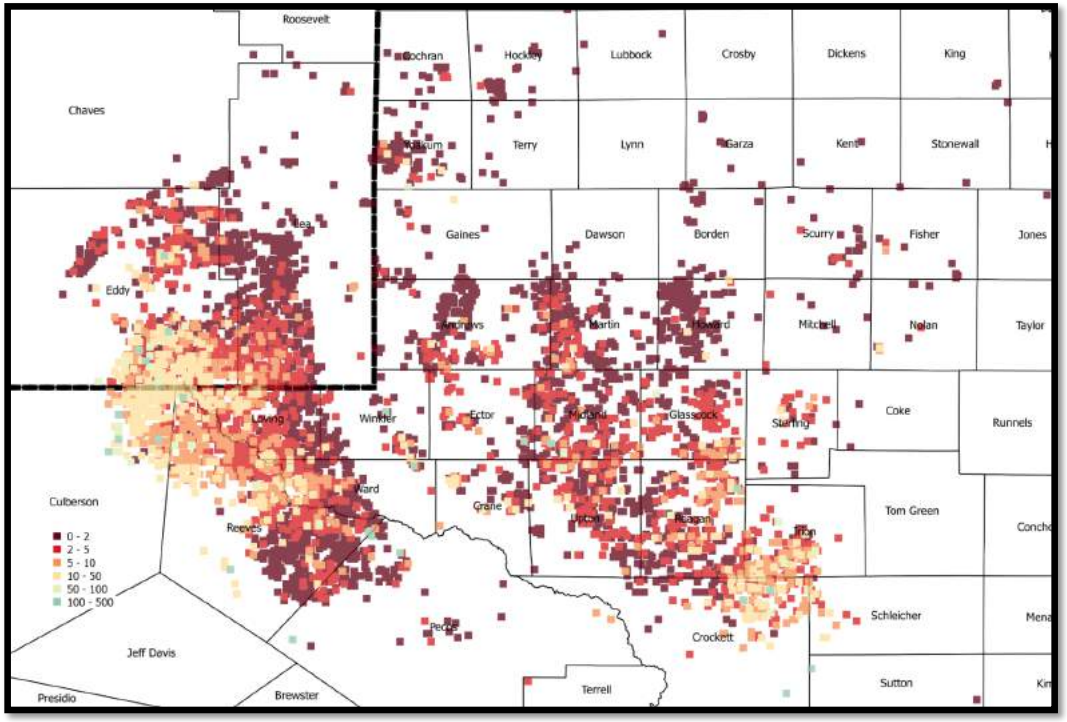
Associated Gas and Produced Water

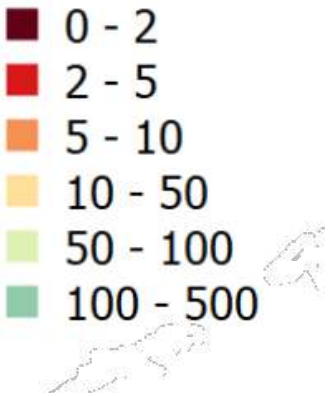




Source: PetroNerds, DrillingInfo data

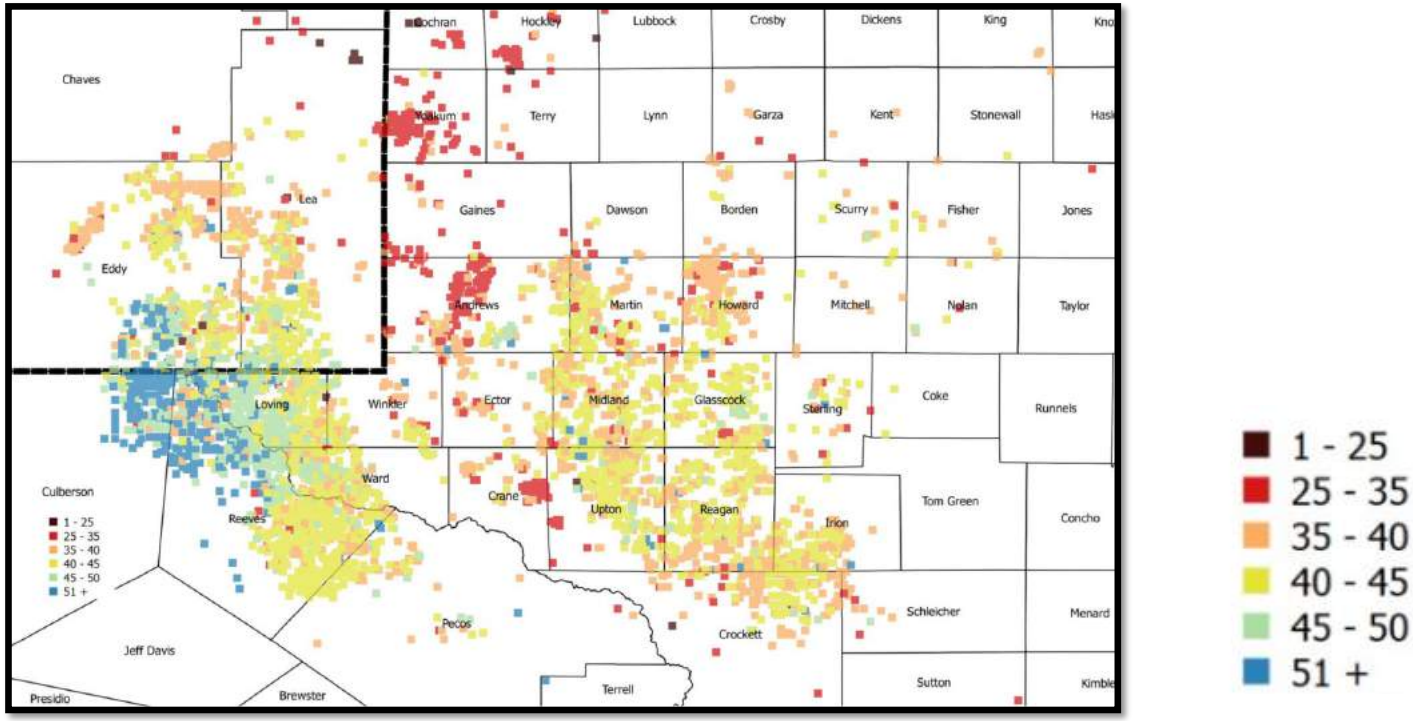
Gas to Oil Ratio in the Permian Basin





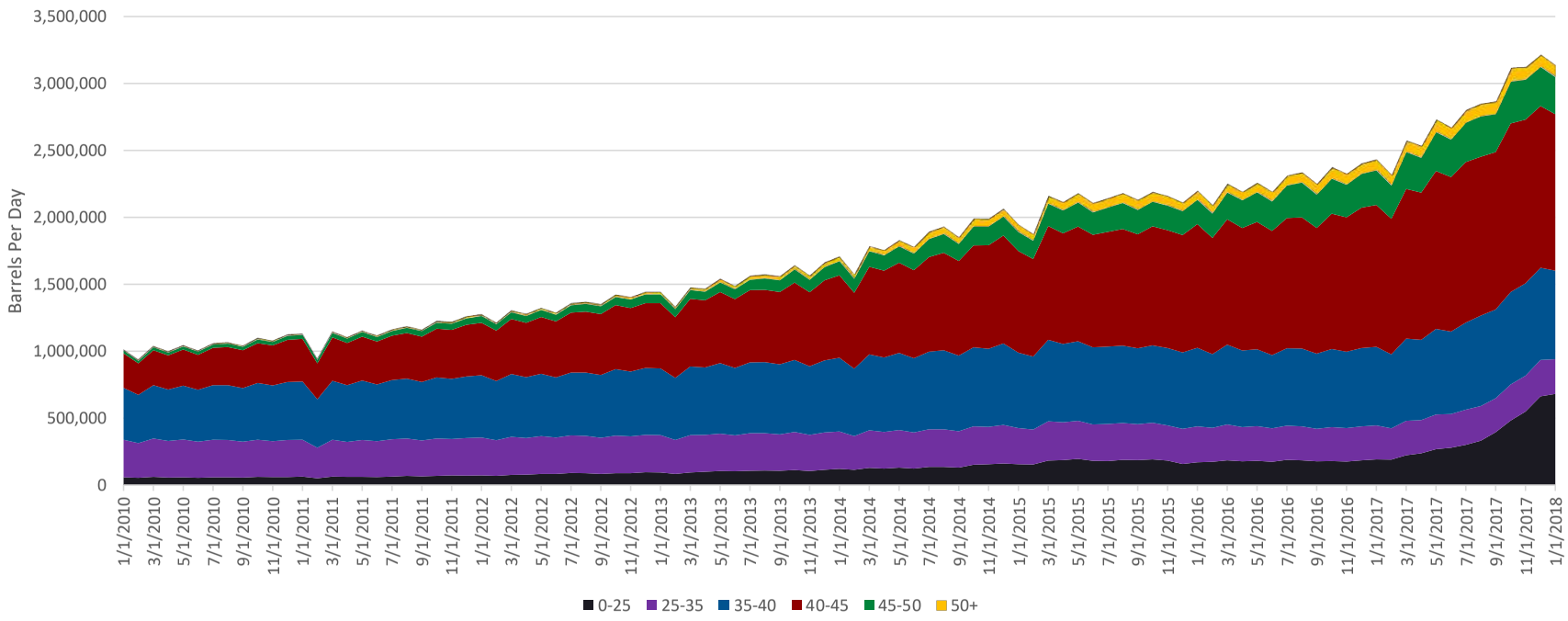
Source: PetroNerds, DrillingInfo data

API Gravity in the Permian Basin



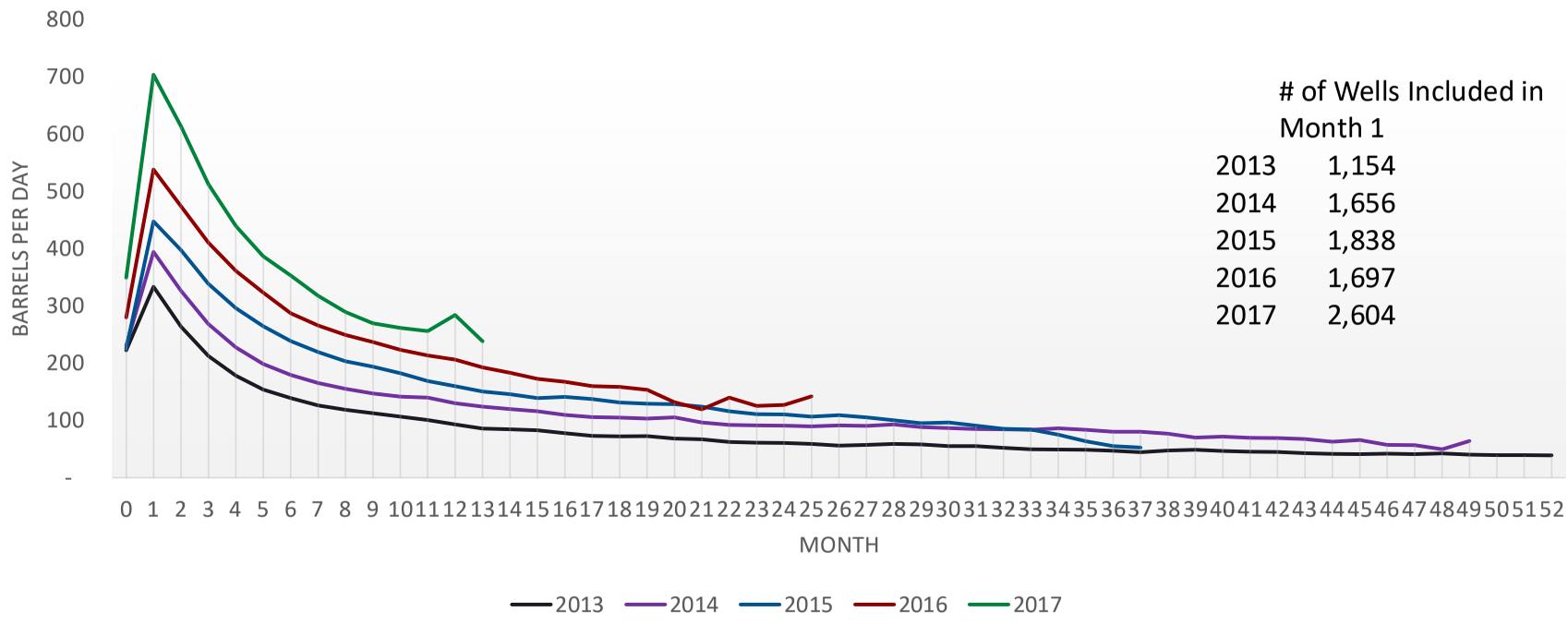
Source: PetroNerds, DrillingInfo data

Production by API Gravity



Source: PetroNerds, DrillingInfo data

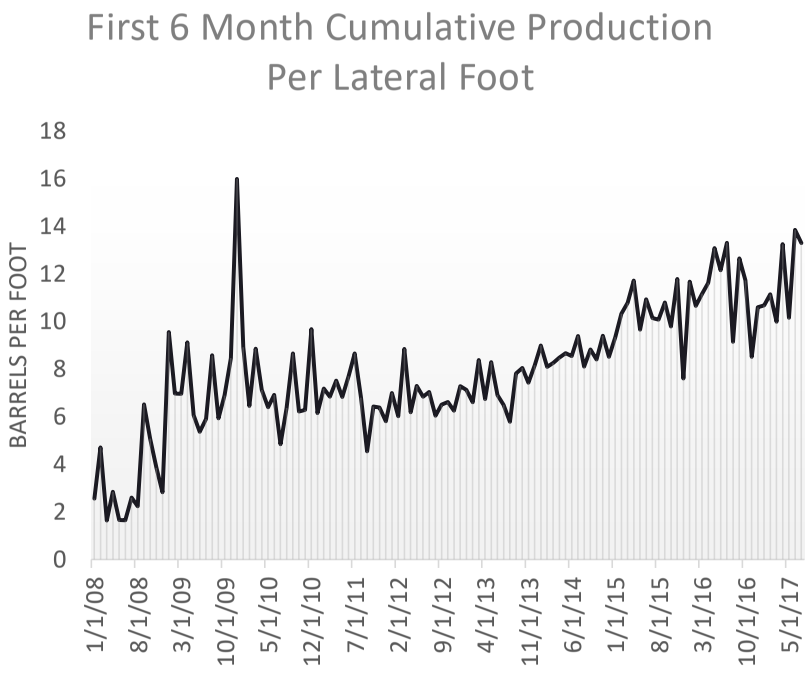
Permian Basin Decline Curve

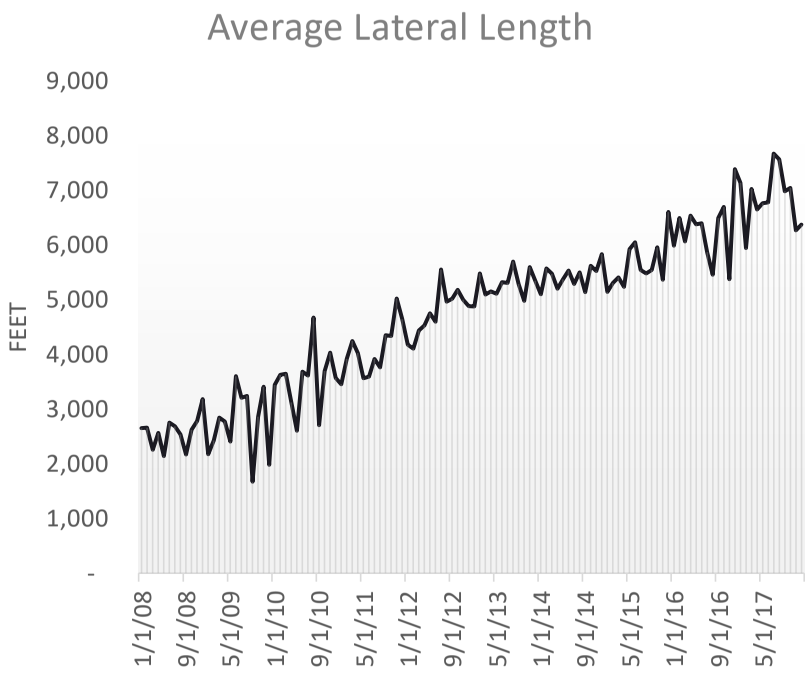


	# of Wells Included in Month 1
2013	1,154
2014	1,656
2015	1,838
2016	1,697
2017	2,604

Source: PetroNerds, DrillingInfo data

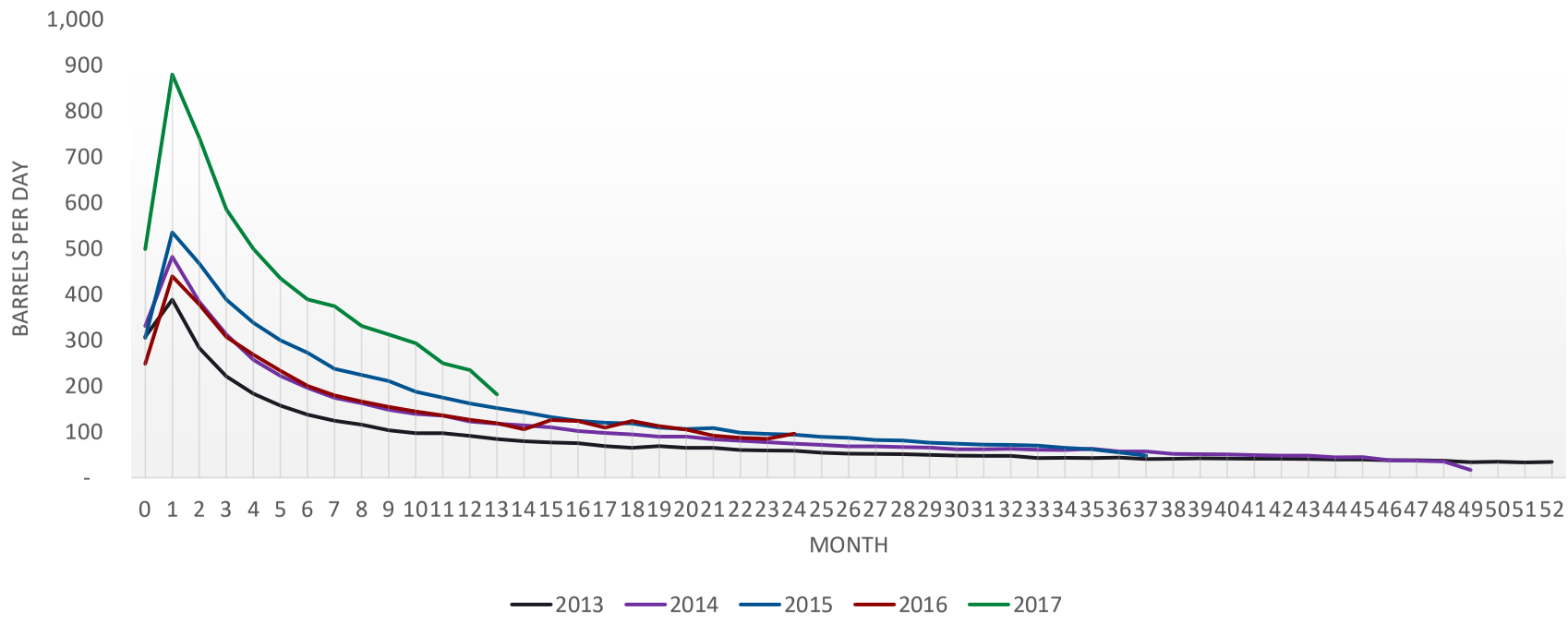
Measuring Productivity





Source: PetroNerds, DrillingInfo data

Bone Spring Reservoir Decline Curve



Source: PetroNerds, DrillingInfo data

Top Permian Basin Operators by Production

	Operator	Daily Liquids b/d	Daily Gas mcf/d
1	OCCIDENTAL ENERGY COMPANYINC.	276,024	556,347
2	PIONEER NATURAL RESOURCES COMPANY	210,694	461,204
3	CONCHO RESOURCES INC.	197,709	659,170
4	EOG RESOURCES INCORPORATED	131,031	407,233
5	APACHE CORPORATION	102,584	477,368
6	EXXON MOBIL CORPORATION	91,408	285,160
7	ANADARKO E&P ONSHORE LLC	88,790	295,583
8	DIAMONDBACK E&P LLC	83,932	123,888
9	CHEVRON U.S.A. INC.	82,071	397,068
10	ENCANA CORPORATION	72,643	157,580
11	PARSLEY ENERGY OPERATIONS LLC	71,987	184,253
12	ENERGEN CORPORATION	68,566	234,231
13	CIMAREX ENERGY COMPANY	64,035	477,567
14	KINDER MORGAN INCORPORATED	51,368	158,186
15	RSP PERMIAN LLC	49,326	104,704
16	MEWBOURNE HOLDINGS INC	48,960	202,757
17	RD SHELL	47,638	117,148
18	DEVON ENERGY CORPORATION	45,105	177,719
19	SURGE OPERATING LLC	44,011	42,721
20	SM ENERGY COMPANY	40,563	73,676
21	LAREDO PETROLEUM INC.	37,173	214,359
22	CENTENNIAL RESOURCE PRODUCTION LLC	35,086	81,964
23	RKI EXPLORATION & PRODUCTION LLC	35,030	185,845
24	JAGGED PEAK ENERGY LLC	30,546	50,148
25	ENDEAVOR ENERGY RESOURCES LP	30,464	63,261

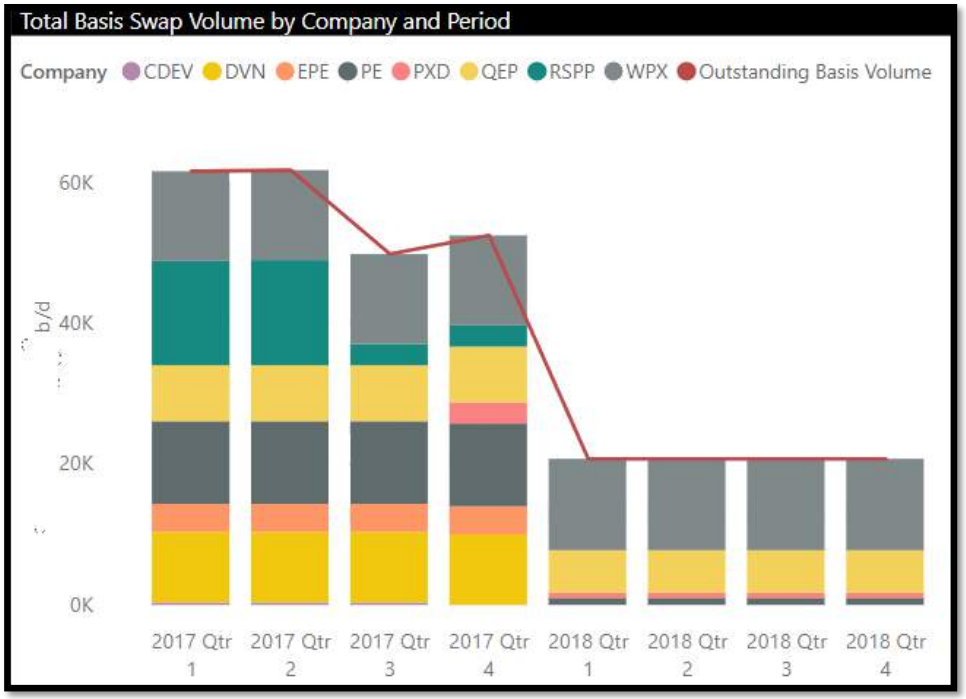
Source: PetroNerds, DrillingInfo data

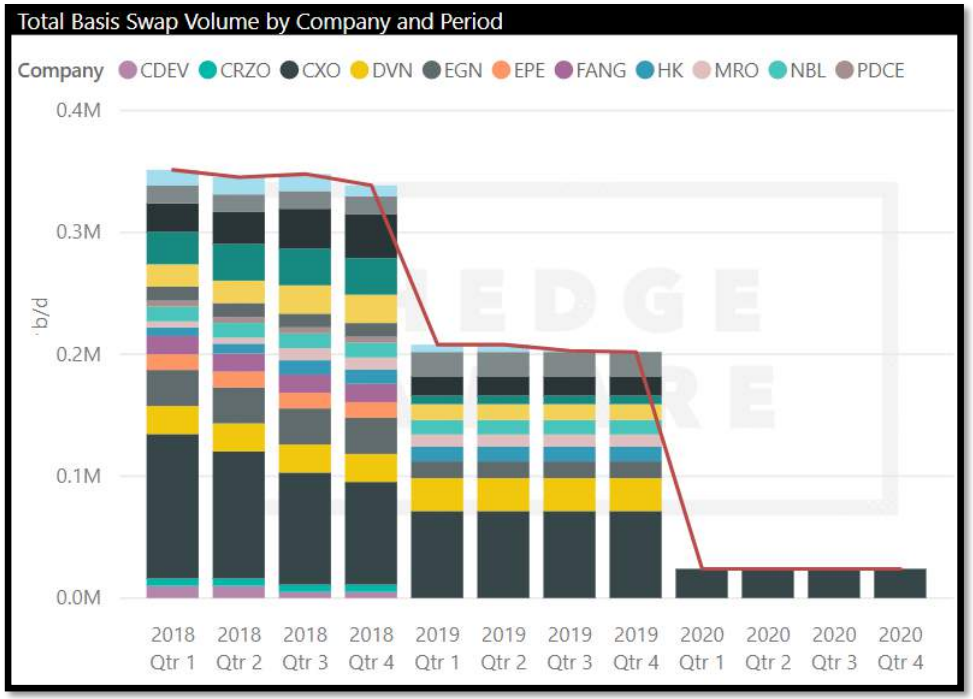
Why Everyone Now Cares about "Basis Swaps"

Operators can protect themselves against capacity constraints for both oil and gas through outright derivative hedges as well as basis swaps.

Flurry of investor concerns about capacity constraints.

Midland Basis Swaps: Q4 2016 vs Q4 2017





Source: PetroNerds, HedgeAware. Survey of 41 publicly traded E&Ps.

Natural Gas: A Role for Public Lands?

The Institute for Energy Research
Tom Pyle, President — @TomJPyle

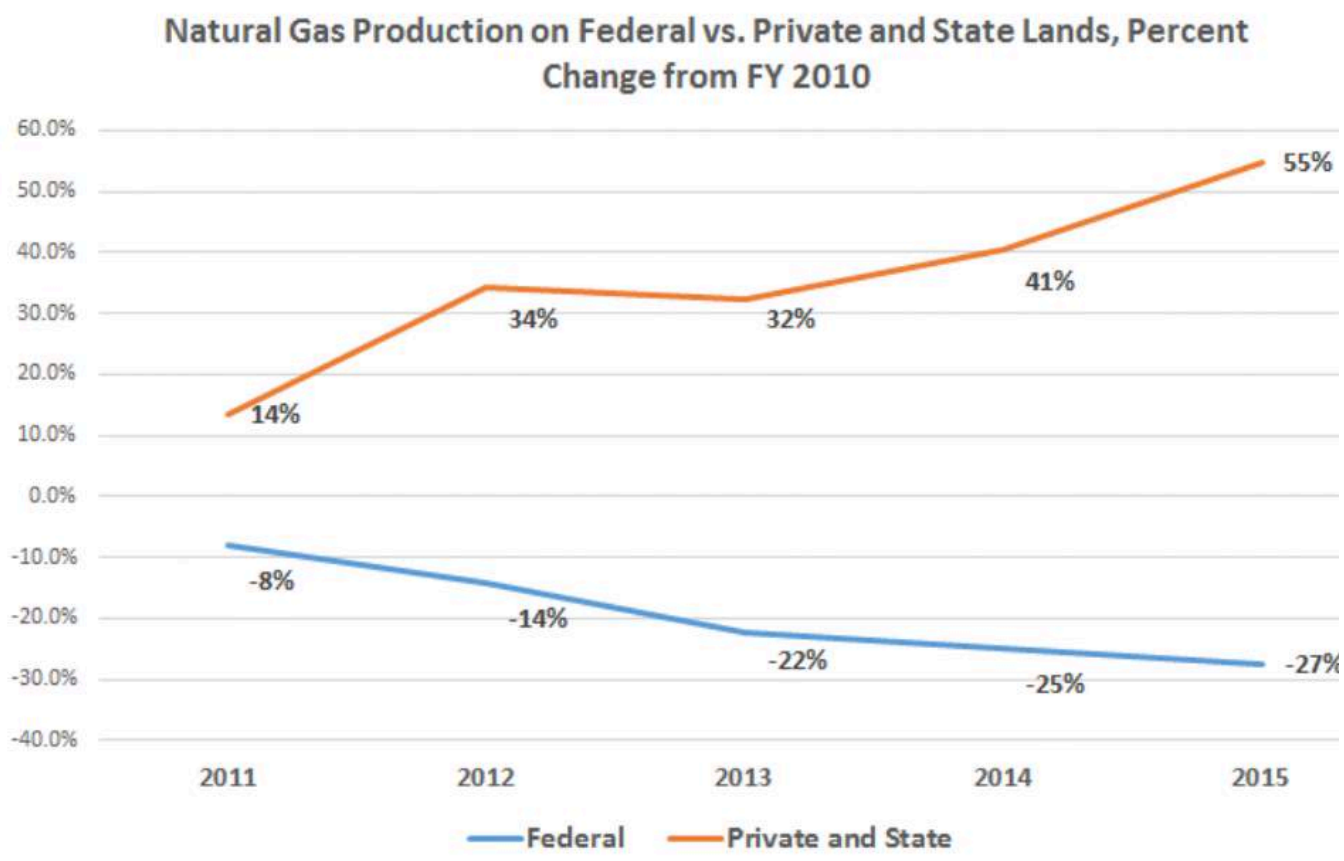
Natural Gas Resources

- We have more gas than we know what to do with.
- 1980 DOE estimate: U.S. had 35 years' worth of natural gas.
- Today, 37 years later, DOE estimate: 100 years.

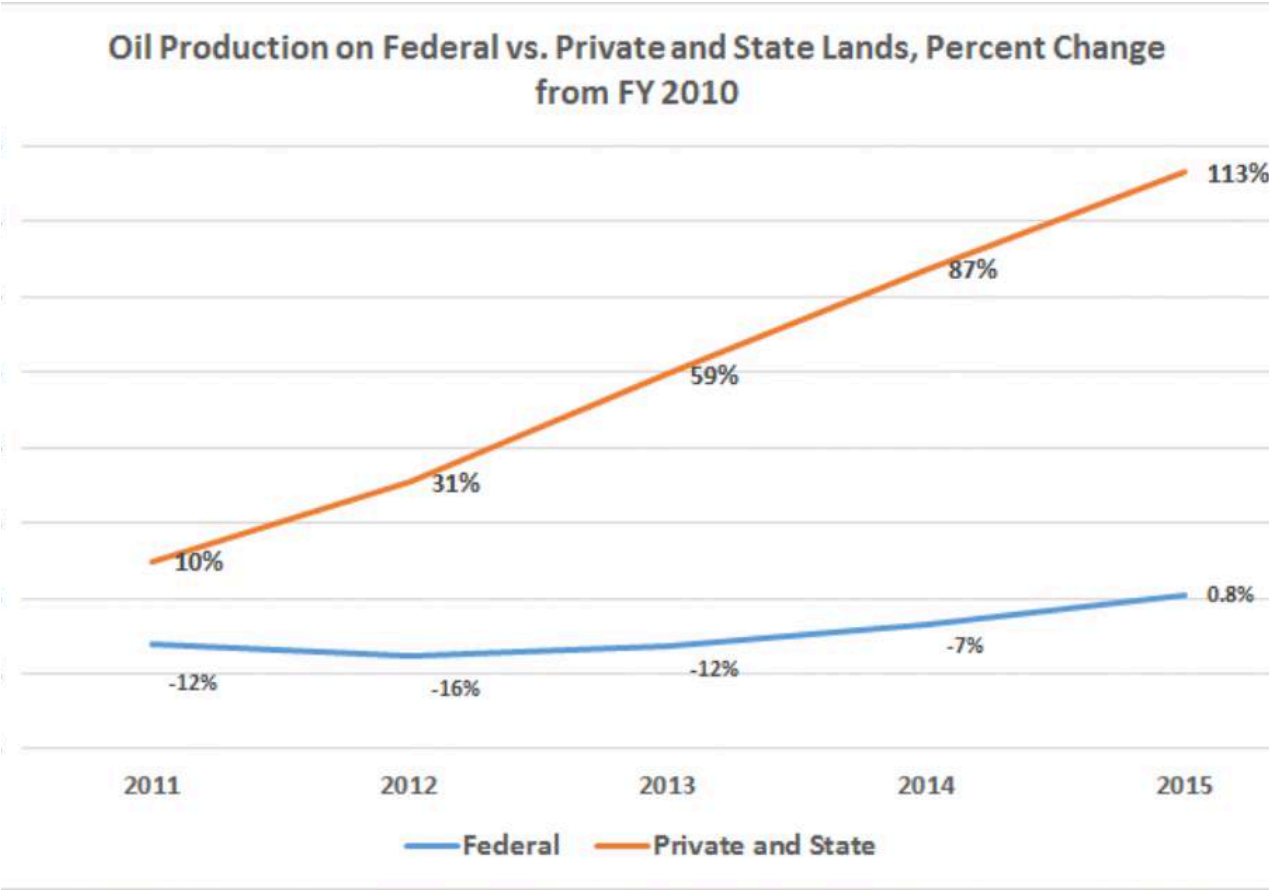
Shale Revolution

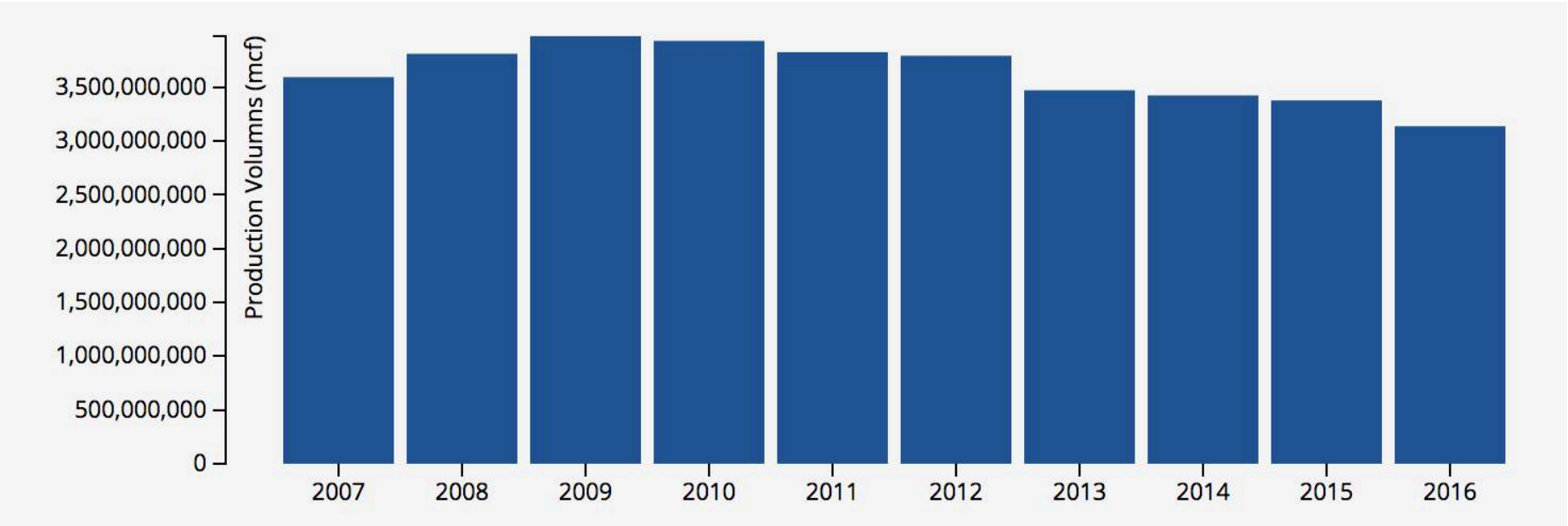
- The Shale Revolution changed everything
- Technology, private and state lands, property rights
- 50 percent surge in production
- Price cut in half

What role have federal lands played?

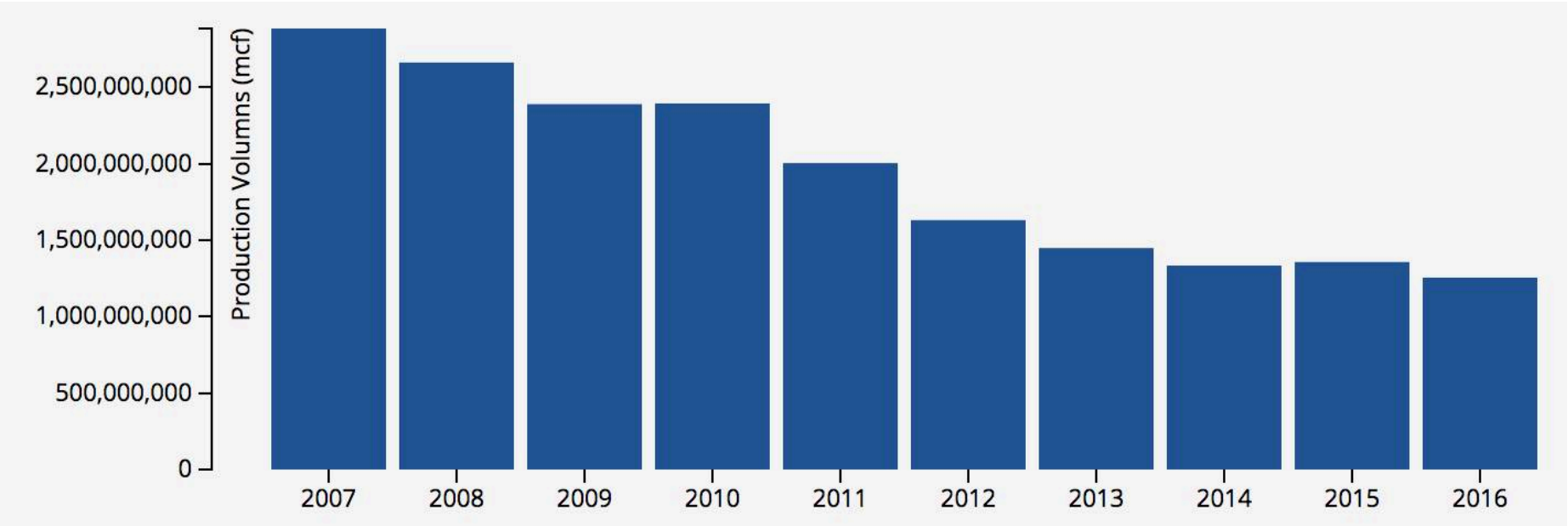


What role have federal lands played?





Federal Onshore Gas Production Volume (mcf)

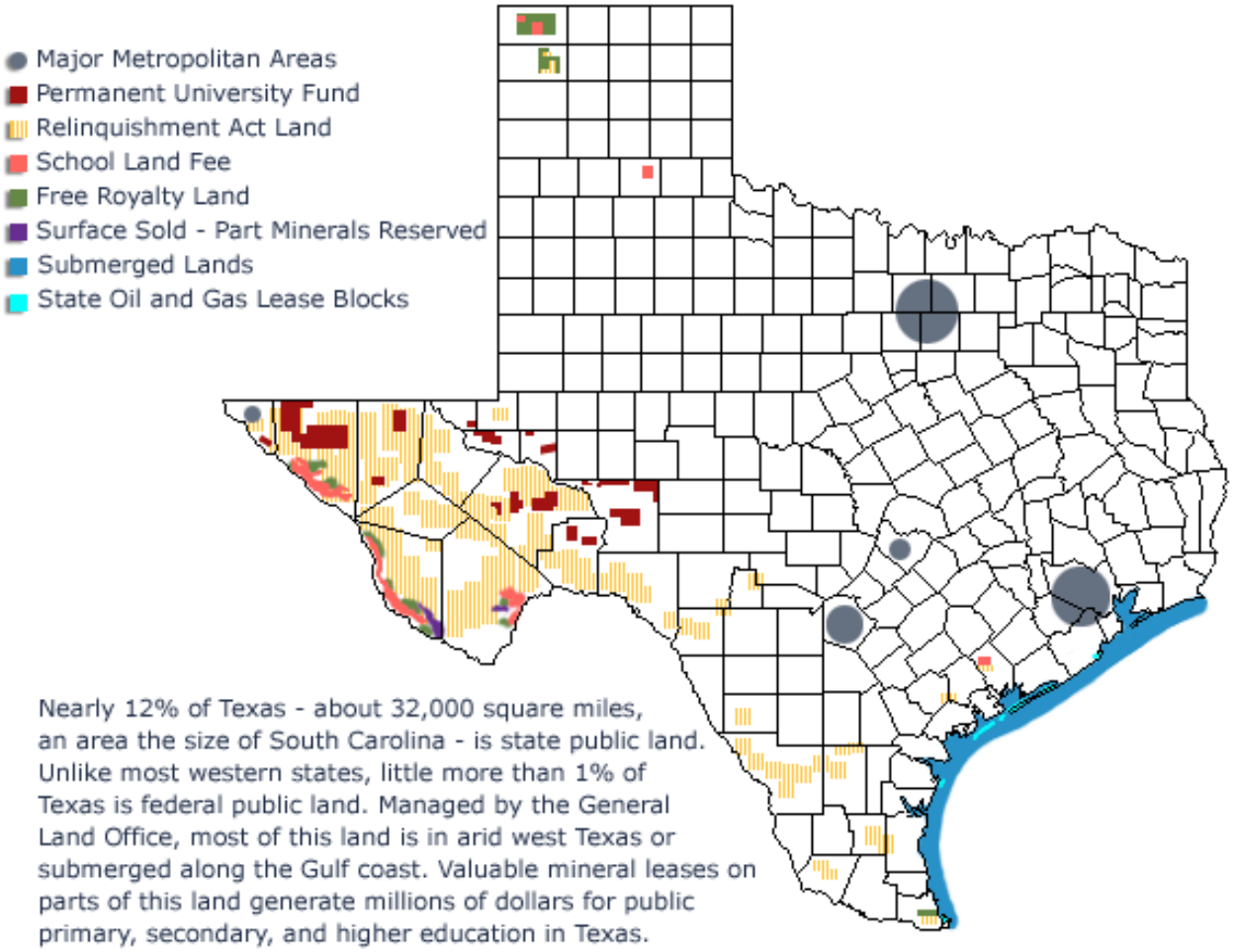


Federal Offshore Gas Production Volume (mcf)

Why the Production Gap?

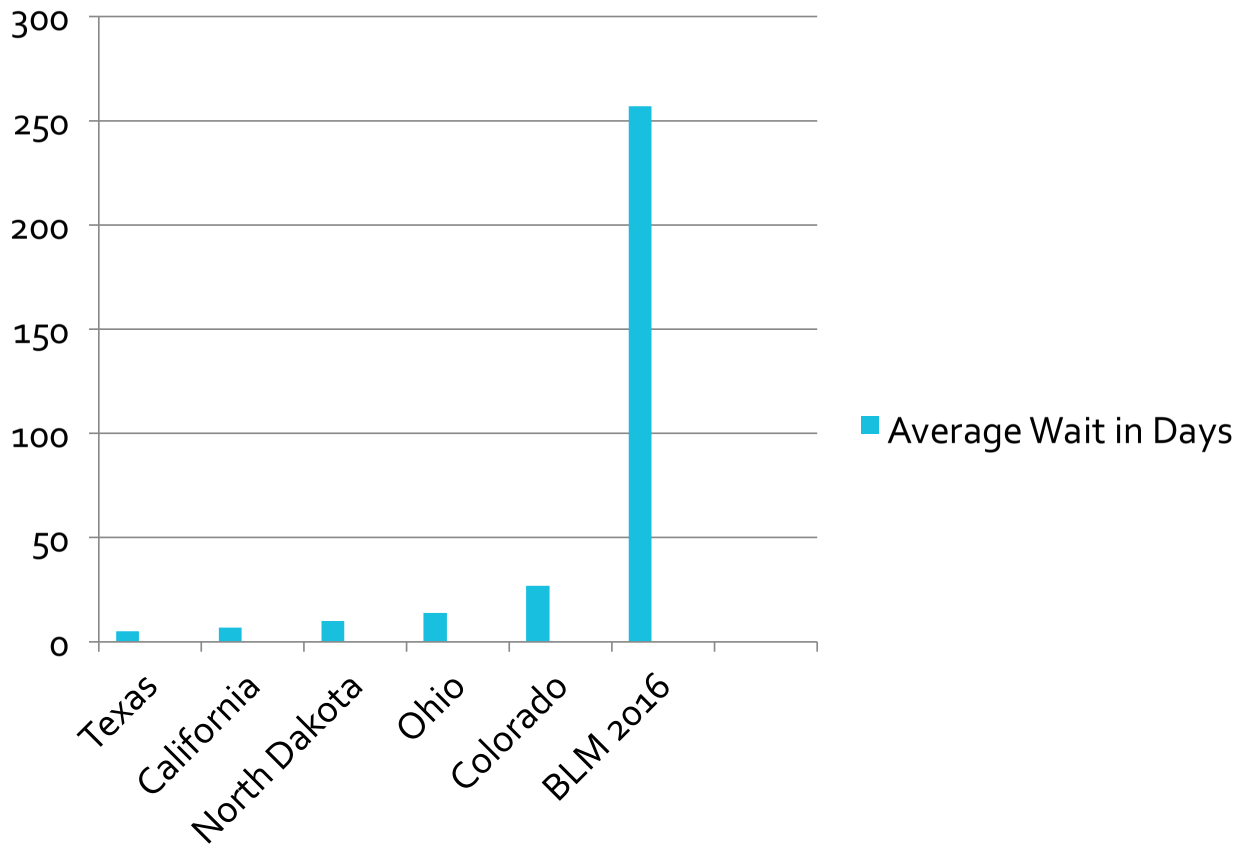
Private Land Ownership

Texas Public Lands

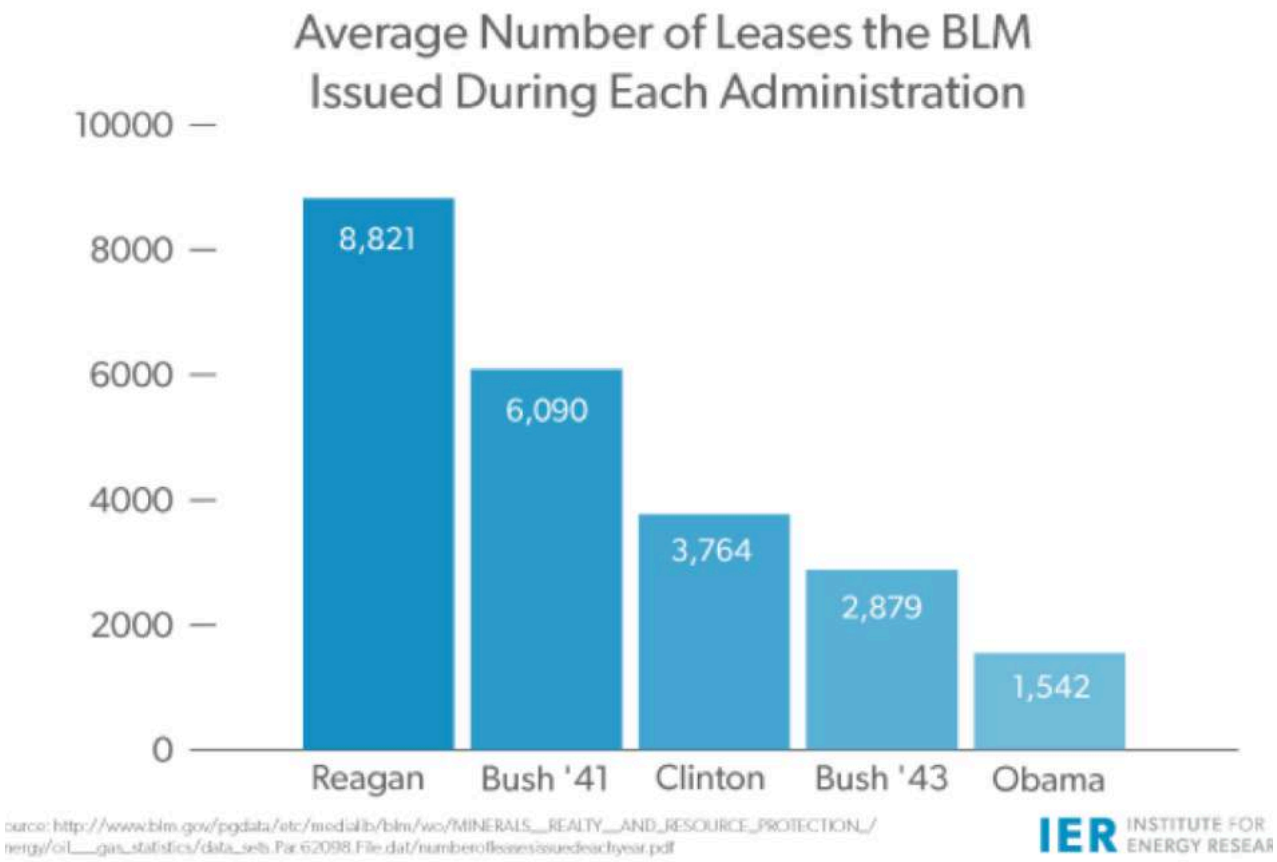


Nearly 12% of Texas - about 32,000 square miles, an area the size of South Carolina - is state public land. Unlike most western states, little more than 1% of Texas is federal public land. Managed by the General Land Office, most of this land is in arid west Texas or submerged along the Gulf coast. Valuable mineral leases on parts of this land generate millions of dollars for public primary, secondary, and higher education in Texas.

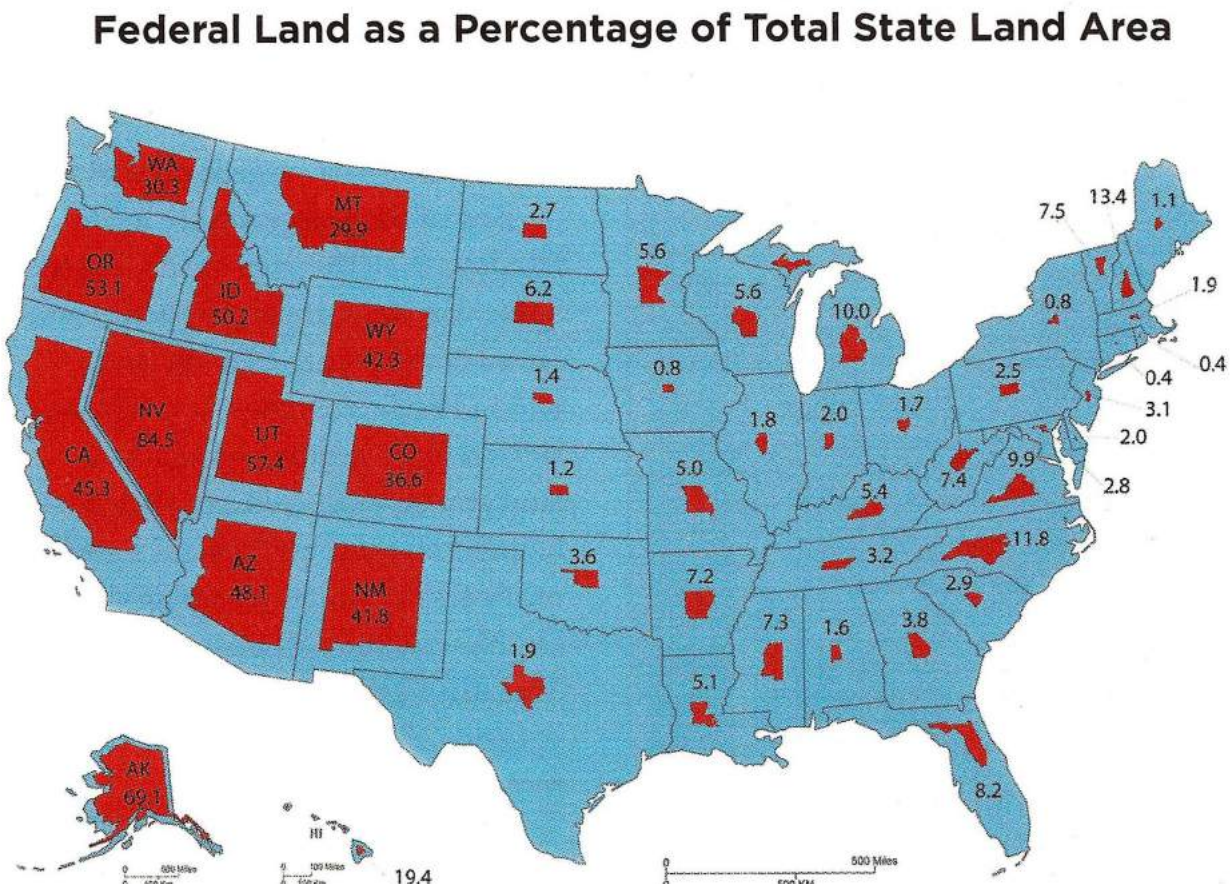
Permitting: Federal vs. State



This trend didn't begin with the Obama Administration



What are we leaving on the table?



IER Study: Economic Benefits of Federal Lands Production

TABLE A2: VALUE OF OIL AND GAS RESERVES AND INVESTMENT ALLOCATED TO REGIONS & STATES
(VALUES IN BILLIONS)

REGION	STATE	LENGTH OF COASTLINE	% OF REGIONAL COASTLINE	OIL BOE BILLIONS OF BOE	GAS MCF	VALUE OF RESERVES ($BILLIONS)
ATLANTIC	MAINE	228	11%	0.32	3.48	$50.2
ATLANTIC	NEW HAMPSHIRE	13	1%	0.02	0.20	$2.9
ATLANTIC	MASSACHUSETTS	192	9%	0.27	2.93	$42.2
ATLANTIC	RHODE ISLAND	40	2%	0.06	0.61	$8.8
ATLANTIC	CONNECTICUT	96	4%	0.13	1.46	$21.1
ATLANTIC	NEW YORK	127	6%	0.18	1.94	$27.9
ATLANTIC	NEW JERSEY	130	6%	0.18	1.98	$28.6
ATLANTIC	DELAWARE	28	1%	0.04	0.43	$6.2
ATLANTIC	MARYLAND	31	1%	0.04	0.47	$6.8
ATLANTIC	VIRGINIA	112	5%	0.16	1.71	$24.6
ATLANTIC	NORTH CAROLINA	301	14%	0.42	4.59	$66.2
ATLANTIC	SOUTH CAROLINA	187	9%	0.26	2.85	$41.1
ATLANTIC	GEORGIA	100	5%	0.14	1.52	$22.0
ATLANTIC	FLORIDA	580	27%	0.80	8.84	$127.6
EASTERN GULF	FLORIDA	770	100%	6.00	11.00	$361.4
PACIFIC	CALIFORNIA	840	65%	6.50	7.15	$695.6
PACIFIC	OREGON	296	23%	2.29	2.52	$245.1
PACIFIC	WASHINGTON	157	12%	1.21	1.34	$130.0
ANWR	ALASKA	-	100%	8.00	0.00	$810.7
UNITED STATES ONSHORE & OFFSHORE OIL AND GAS				34.00	95.00	$3,933.4

What's the proper perspective on the role of public land?

Solutions

- Divestment
- State Management
- Streamline Permitting Process
- Accurate Inventory of Resource Base
- Revenue Sharing with States

"It's tough to make predictions, especially about the future…"

…but there will always be a role for public lands.

Tom Pyle — @TomJPyle

instituteforenergyresearch.org

Importance of Infrastructure for LNG Export

Adrian Reed SVP
Strategy and Risk
Tellurian Inc.

April 2018

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Cautionary statements

Forward looking statements

The information in this presentation includes "forward-looking statements" within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended. All statements other than statements of historical fact are forward-looking statements. The words "anticipate," "assume," "believe," "budget," "estimate," "expect," "forecast," "initial," "intend," "may," "plan," "potential," "project," "should," "will," "would," and similar expressions are intended to identify forward-looking statements. The forward-looking statements in this presentation relate to, among other things, anticipated supply, demand and other factors that may affect the LNG industry and Driftwood Holdings, including the financing of Driftwood Holdings.

Our forward-looking statements are based on assumptions and analyses made by us in light of our experience and our perception of historical trends, current conditions, expected future developments, and other factors that we believe are appropriate under the circumstances. These statements are subject to numerous known and unknown risks and uncertainties, which may cause actual results to be materially different from any future results or performance expressed or implied by the forward-looking statements. These risks and uncertainties include those described in the "Risk Factors" section of our Annual Report on Form 10-K for the year ended December 31, 2017 filed with the Securities and Exchange Commission (the "SEC") on March 15, 2018 and other filings with the SEC, which are incorporated by reference in this presentation. Many of the forward-looking statements in this presentation relate to events or developments anticipated to occur numerous years in the future, which increases the likelihood that actual results will differ materially from those indicated in such forward-looking statements.

The forward-looking statements made in or in connection with this presentation speak only as of the date hereof. Although we may from time to time voluntarily update our prior forward-looking statements, we disclaim any commitment to do so except as required by securities laws.

Reserves and resources

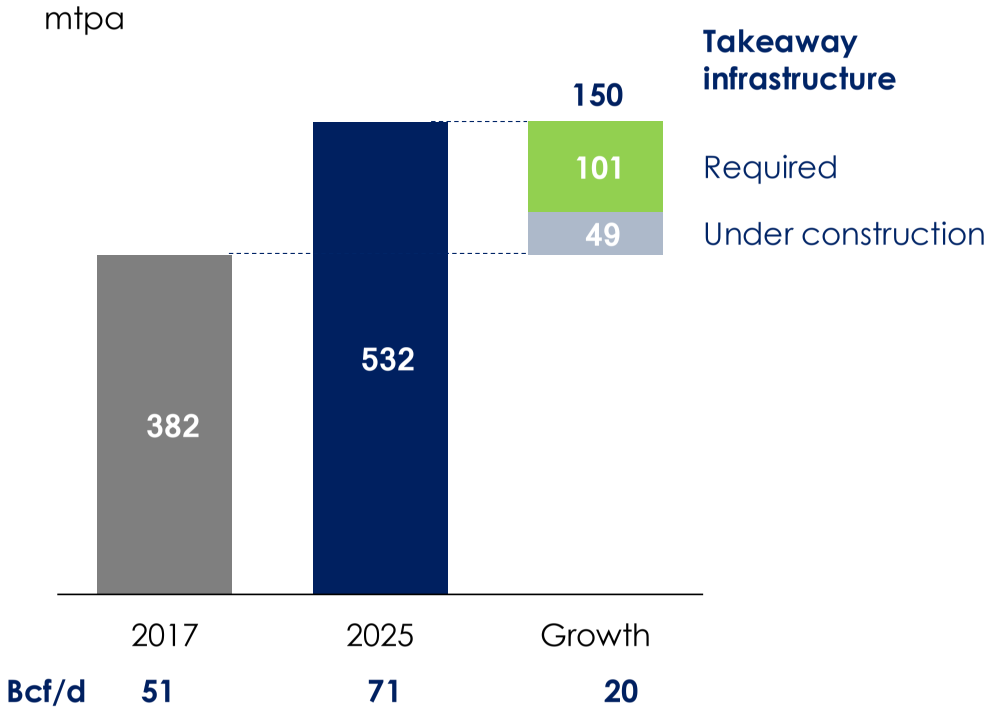
Estimates of non-proved reserves and resources are based on more limited information, and are subject to significantly greater risk of not being produced, than are estimates of proved reserves.

Global call on U.S. natural gas

U.S. supply push…

Output from selected shale basins[1]

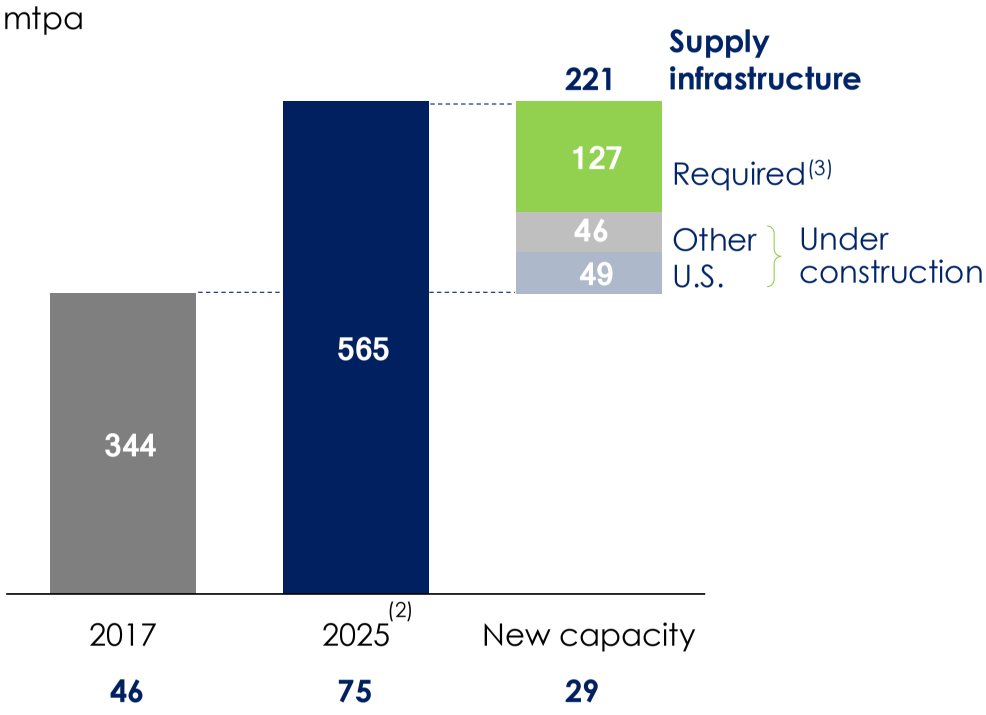
mtpa



…and global demand pull

Global LNG production capacity

mtpa



Source: Wood Mackenzie, Tellurian Research.
Notes: (1) Includes the Permian, Haynesville, Utica, Marcellus, Anadarko, Eagle Ford.
(2) Based on a demand growth estimate of 4.5% post-2020.
(3) Capacity required to meet demand growth post-2020.

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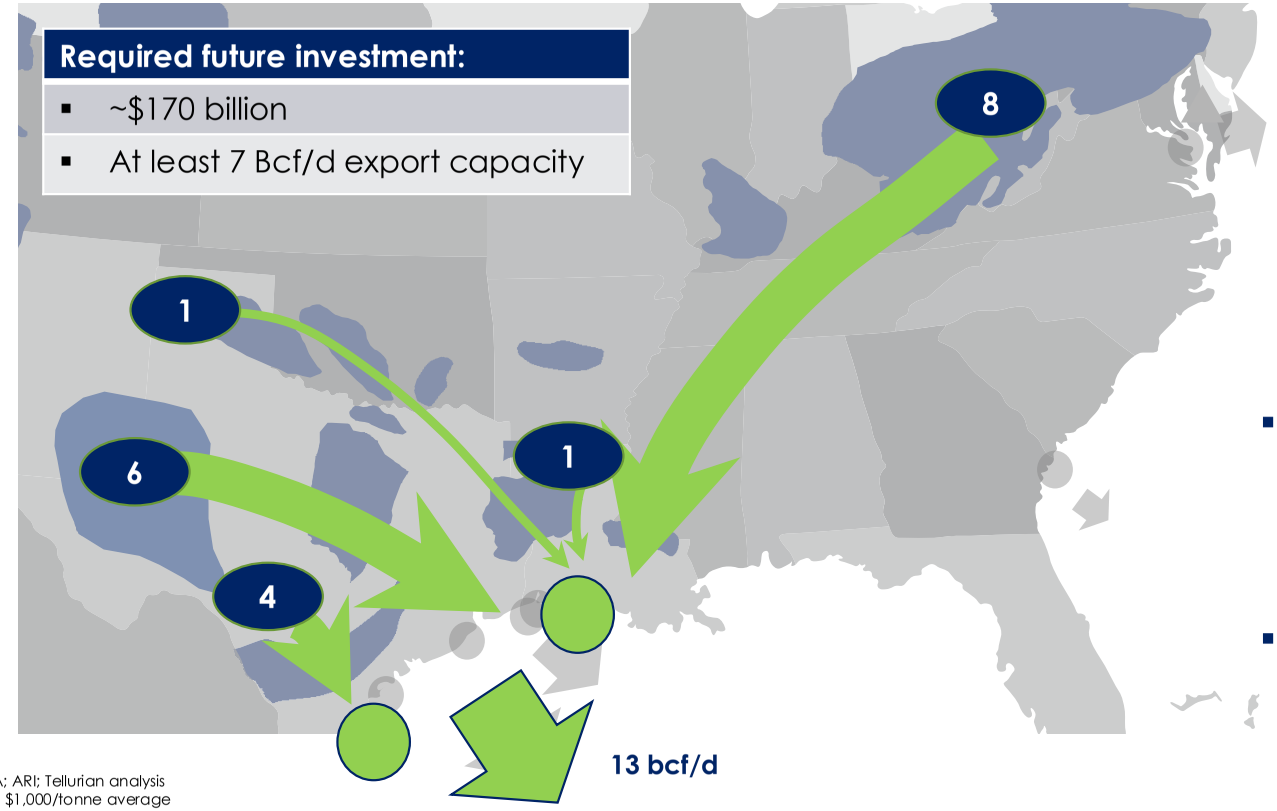
New infrastructure required

13 Bcf/d of incremental production at risk of flaring without additional infrastructure investment



LNG liquefaction terminal

- Operating/under construction
- Future

Export capacity

20 **Total estimated 2017-2025 production growth, Bcf/d**

- LNG export capacity required:
  - Up to 100 mtpa: 13 Bcf/d (20 Bcf/d less ~7 under construction)
  - ~$100 billion[1]
- Pipeline capacity required:
  - Around 20 Bcf/d
  - ~$70 billion

Source: EIA; ARI; Tellurian analysis
Notes: (1) $1,000/tonne average

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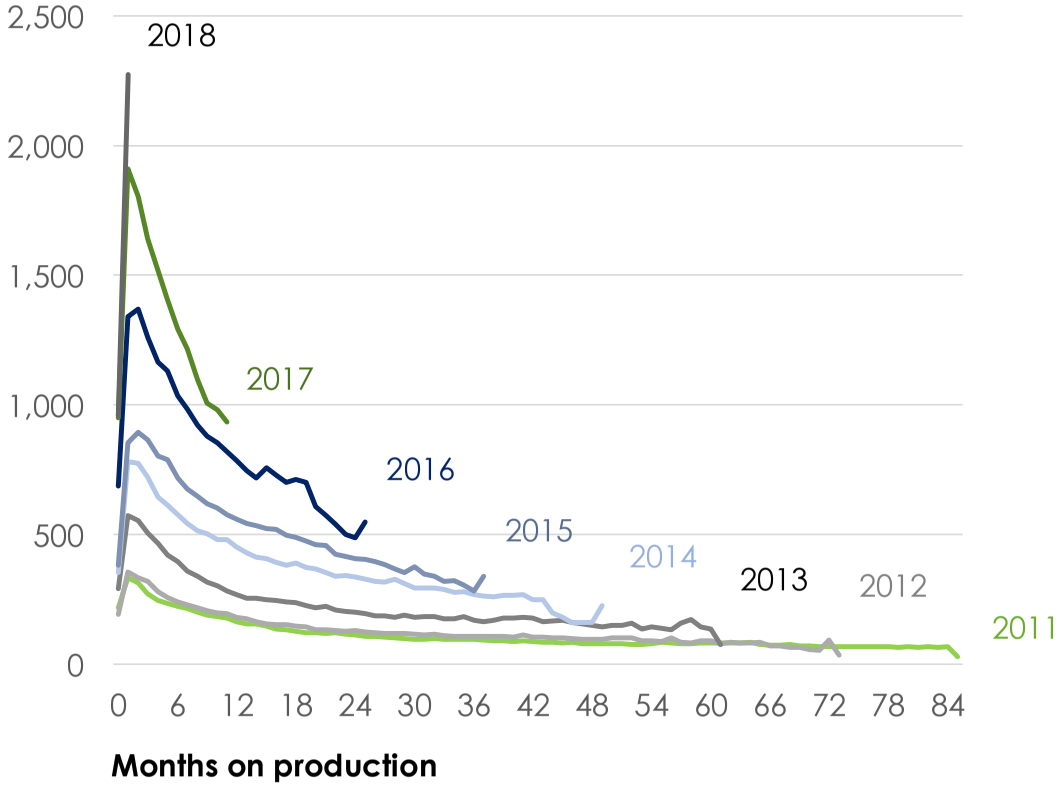
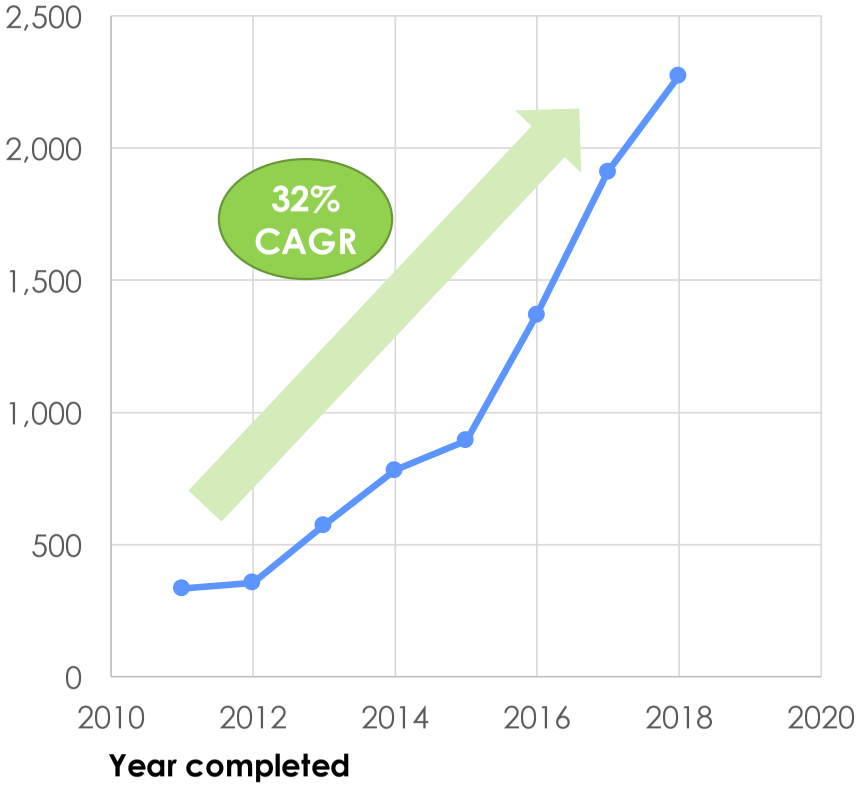
Continued shale revolution productivity improvements

Delaware Basin vintage type curves
mcf/d

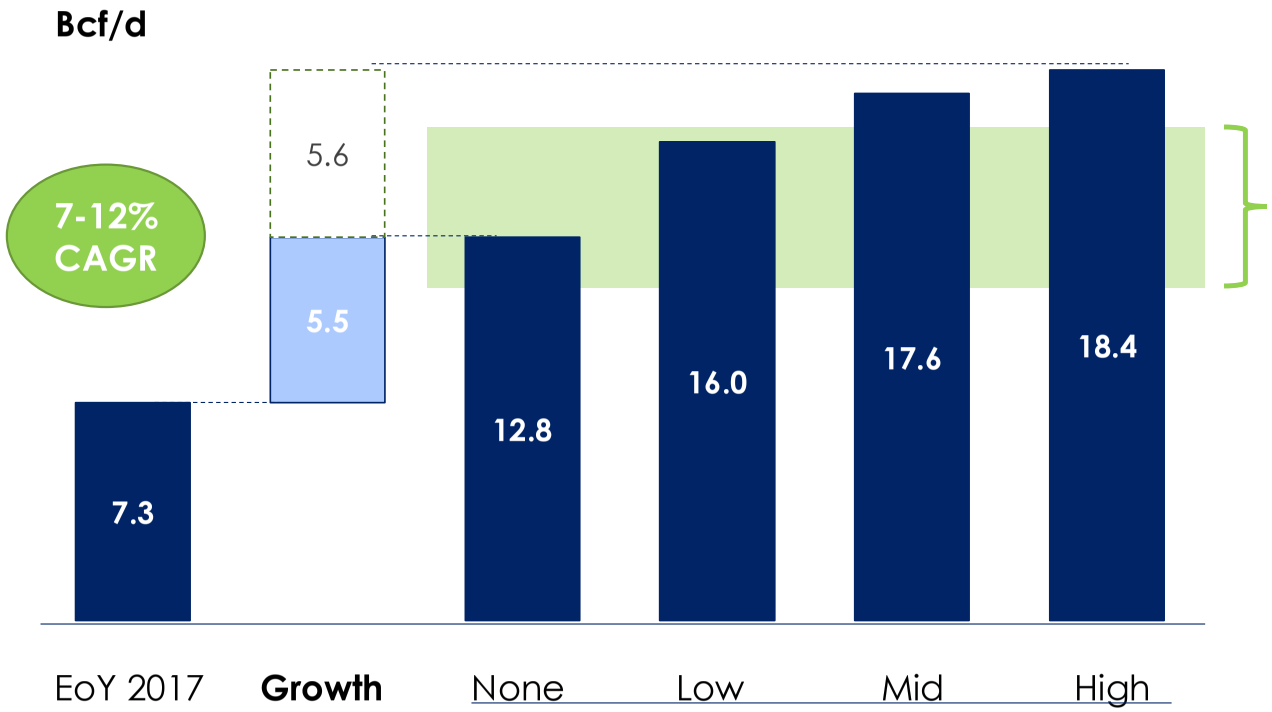


Average Delaware Basin peak month production
mcf/d



Sources: DrillingInfo; Tellurian analysis

Permian gas projections



	EoY 2017	Growth to 2025	None	Low	Mid	High
Wet[1] gas volume, Bcf/d	9.1	5-14	16	20	22	23

Alternative sources:	**Bcf/d**
▪ IHSMarkit	~15
▪ RBN	11-15
▪ BTU analytics	15-17

Notes: 1 Assumes 80% wet gas to dry gas conversion

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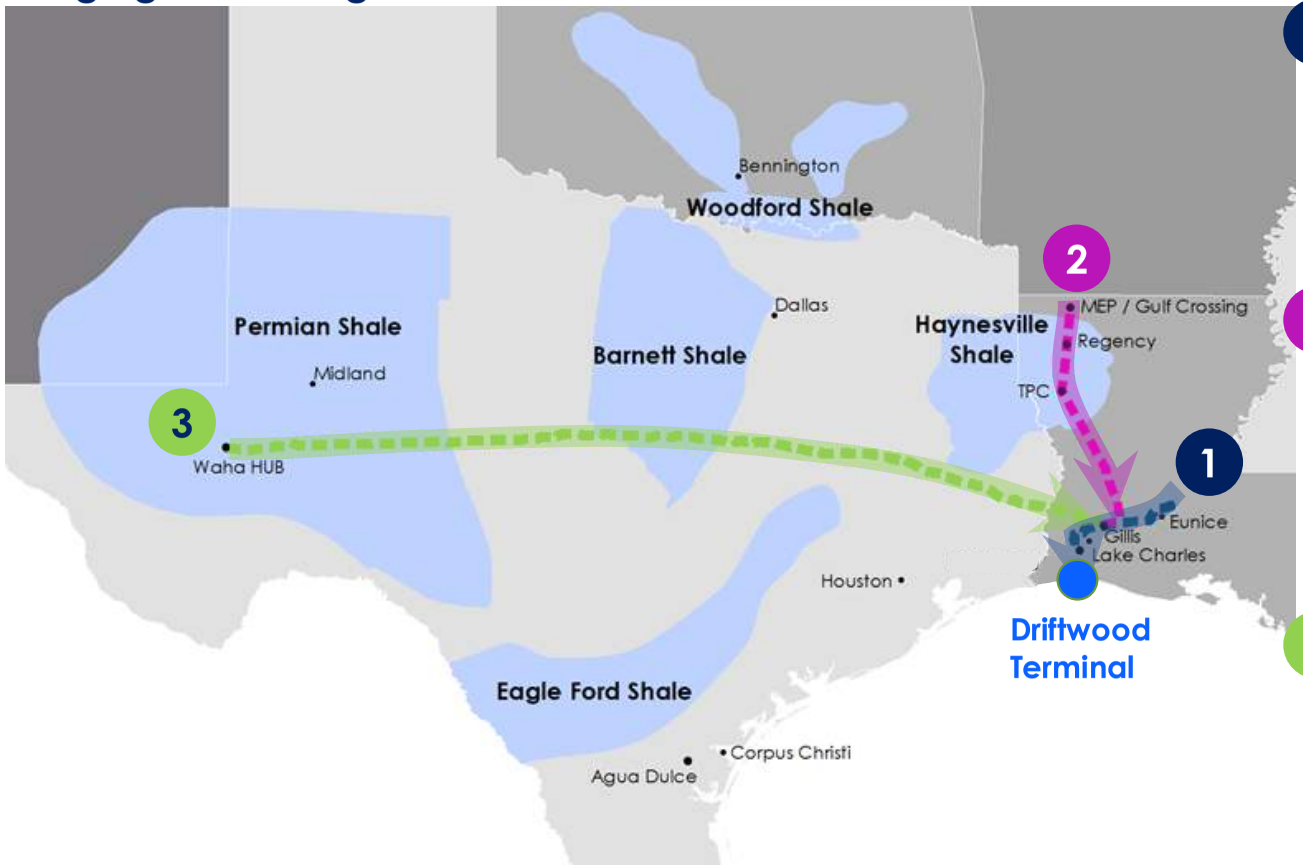
Tellurian pipeline network

Bringing low-cost gas to Southwest Louisiana



1 Driftwood Pipeline[1]	
Capacity (Bcf/d)	4.0
Cost ($ billions)	$2.2
Length (miles)	96
Diameter (inches)	48
Compression (HP)	274,000
Status	FERC approval pending

2 Haynesville Global Access Pipeline[2]	
Capacity (Bcf/d)	2.0
Cost ($ billions)	$1.4
Length (miles)	200
Diameter (inches)	42
Compression (HP)	23,000
Status	Open season: 2/21/18

3 Permian Global Access Pipeline[2]	
Capacity (Bcf/d)	2.0
Cost ($ billions)	$3.7
Length (miles)	625
Diameter (inches)	42
Compression (HP)	258,000
Status	Open season: 3/20/18

Notes: (1) Included in Driftwood Holdings.
(2) Currently not included in Driftwood Holdings illustrative financials (slides 8, 9, 11 and 12); commercial and regulatory in progress and financial structuring under review.

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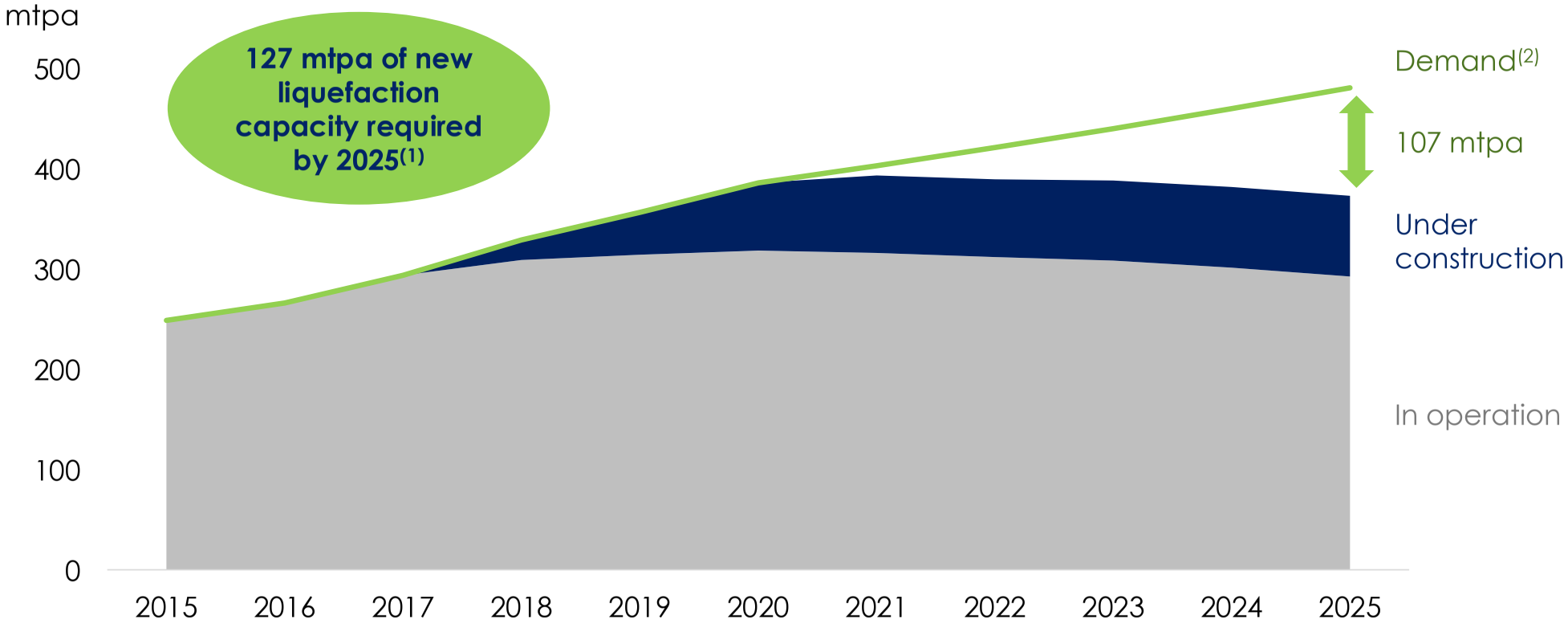
Demand pull

Demand outlook



Sources: Wood Mackenzie, Tellurian Research.
Notes: (1) Assumes 85% utilization rate.
(2) Based on assumption that LNG demand grows at 4.5% p.a. post-2020.

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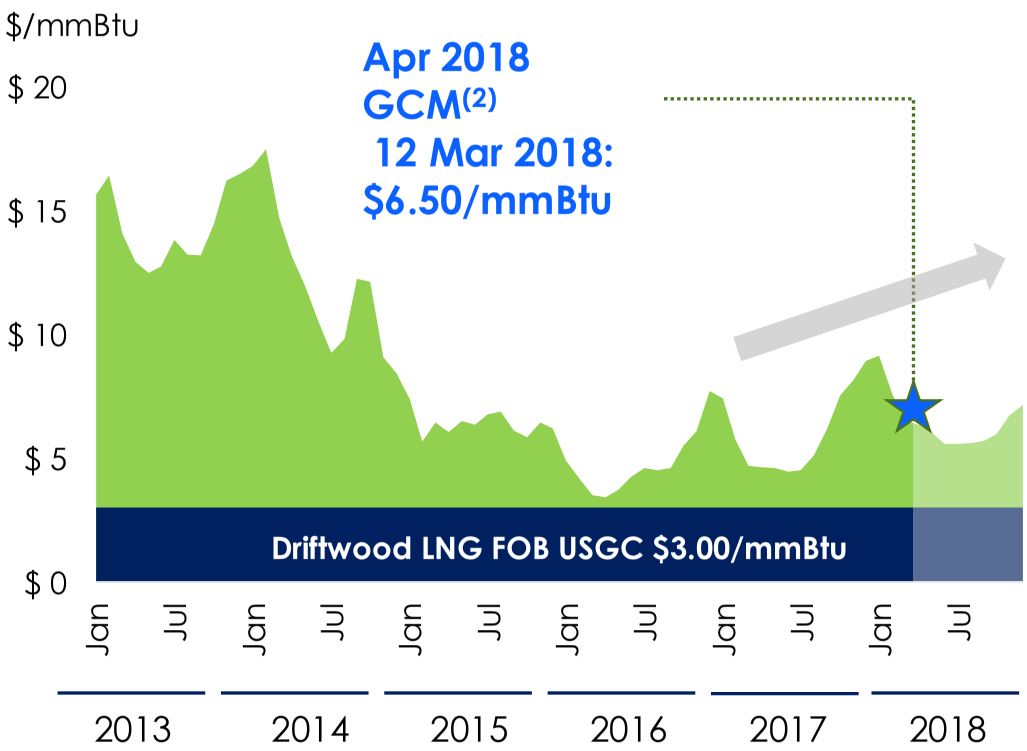
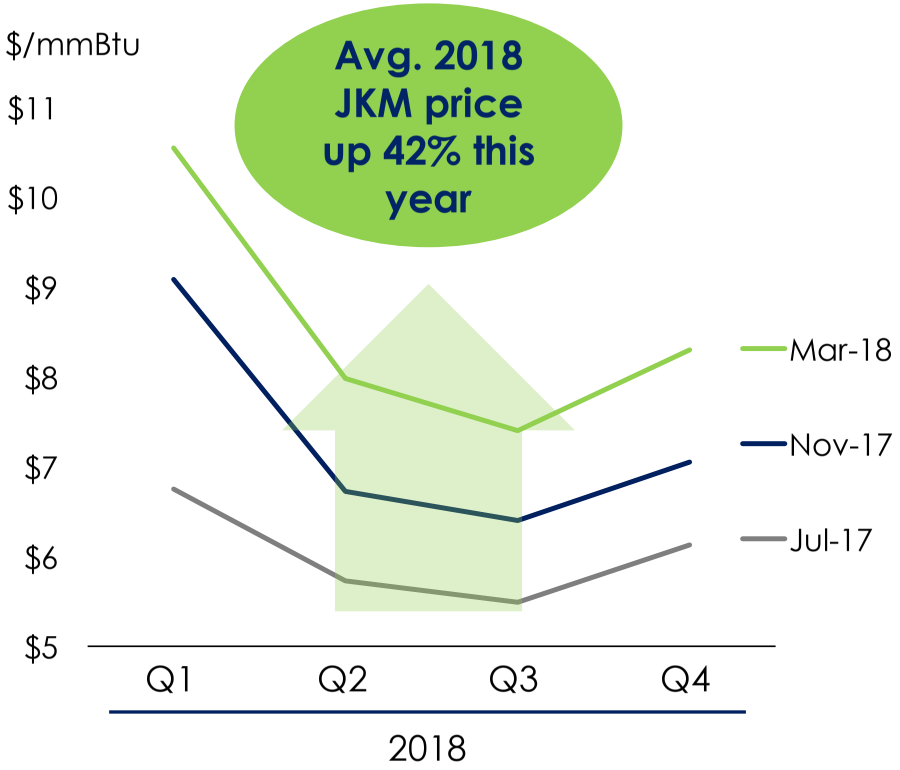
Margins and price signals

Netback prices to the Gulf Coast[1]



2018 JKM forward prices up $2.50 since July 2017



Sources: Platts, CME, Tellurian Research.
Notes: (1) Forward prices for 2018 assuming $1.79/mmBtu shipping cost from USGC to East Asia using Platts JKM.
(2) Platts Gulf Coast Marker.

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Driftwood LNG terminal

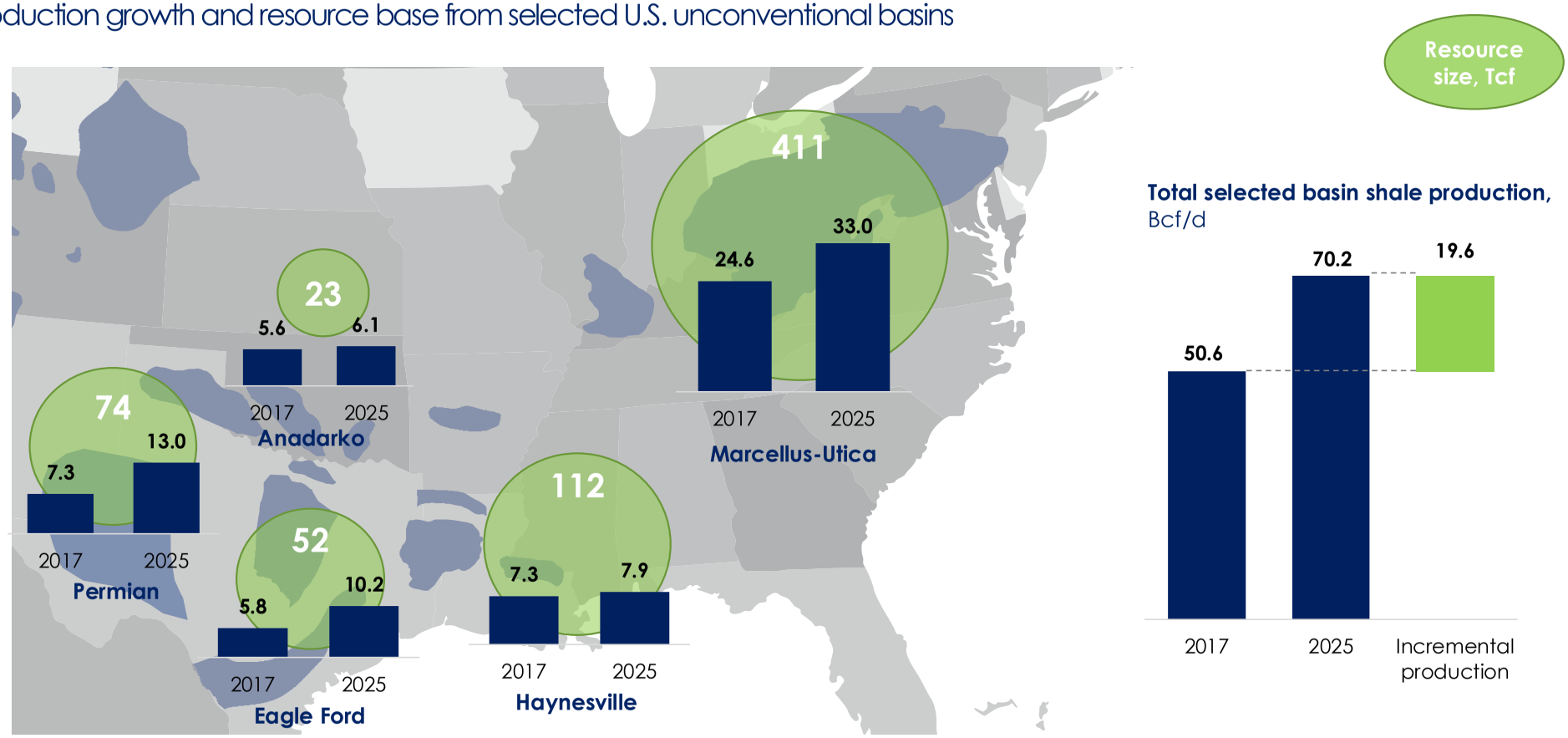
Driftwood LNG terminal	
Land	▪ ~1,000 acres near Lake Charles, LA
Capacity	▪ ~27.6 mtpa
Trains	▪ Up to 20 trains of ~1.38 mtpa each ▪ Chart heat exchangers ▪ GE LM6000 PF+ compressors
Storage	▪ 3 storage tanks ▪ 235,000 m^3 each
Marine	▪ 3 marine berths
EPC Cost	▪ ~$550 per tonne ▪ ~$15.2 billion[1]

Note: (1) Engineering, procurement and construction costs before owners' costs, financing costs and contingencies.

Additional material

Plentiful, cheap U.S. gas endowment

Production growth and resource base from selected U.S. unconventional basins



Source: EIA; Tellurian analysis

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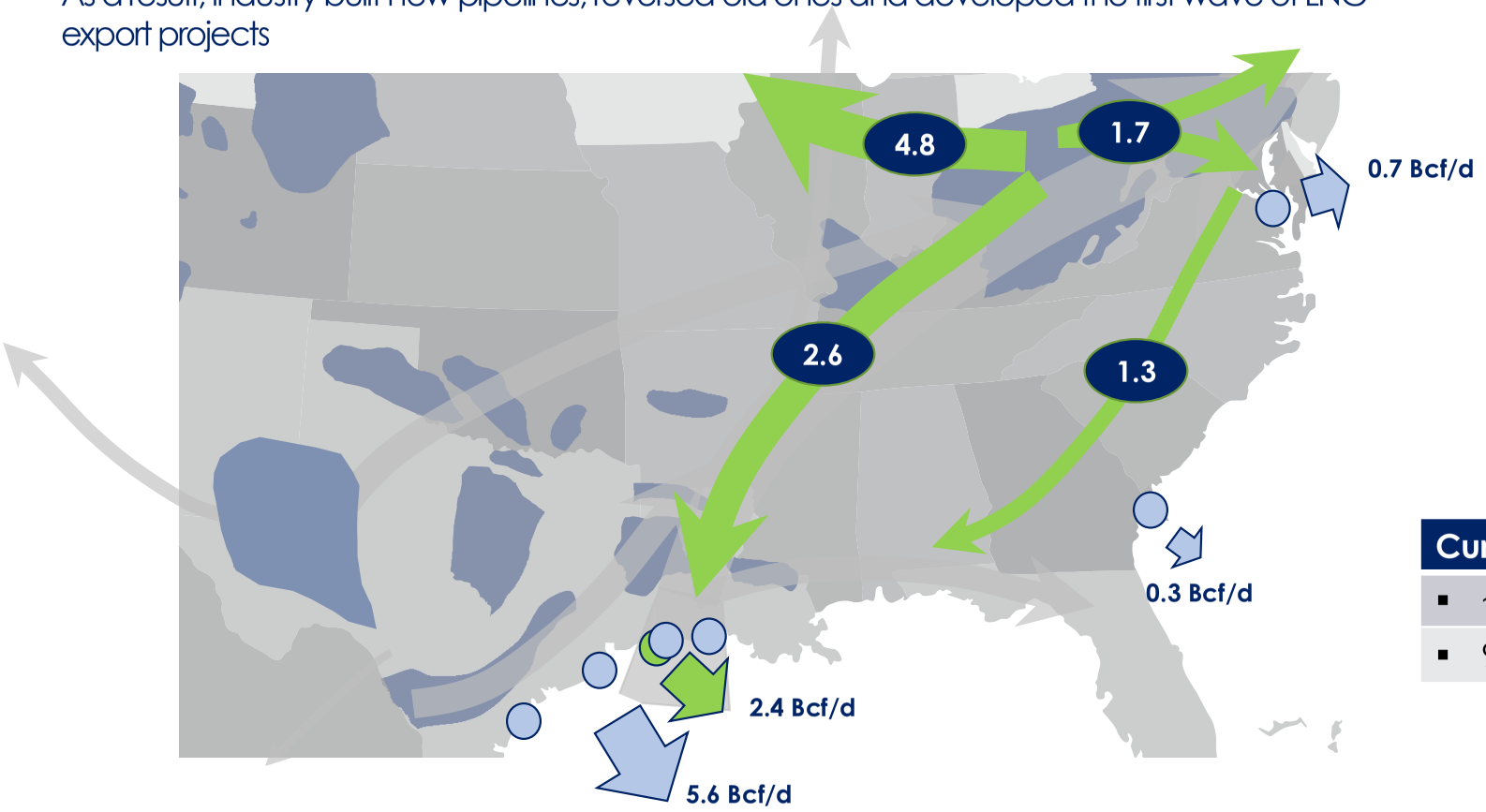
Infrastructure first wave

As a result, industry built new pipelines, reversed old ones and developed the first wave of LNG export projects



LNG liquefaction terminal

- Operating
- Under construction

Export capacity

2.6 **Completed pipeline reversals and new construction, Bcf/d**

Current LNG investment:
▪ ~$60 billion
▪ 9 Bcf/d export capacity

Source: EIA; Wood Mackenzie, RBN, Tellurian analysis.

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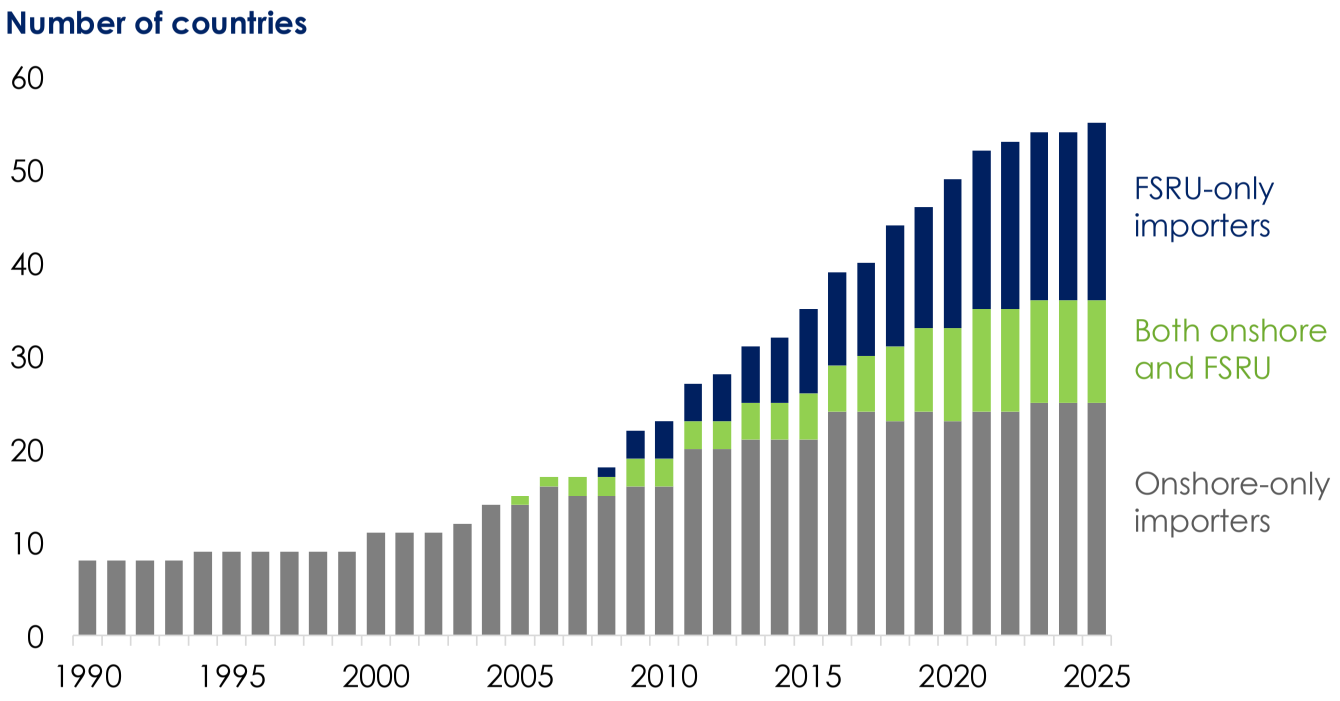
The number of LNG market participants has grown rapidly

FSRU technology is rapidly expanding the number of countries consuming LNG

- Floating storage and regasification units (FSRUs) provide emerging markets a faster and often cheaper option than land-based terminals to begin importing LNG
- By year-end 2017, 40% of import markets utilized FSRUs
- IHS forecasts that over 50% of import markets will utilize FSRU terminals by 2025



Sources: IHS Markit

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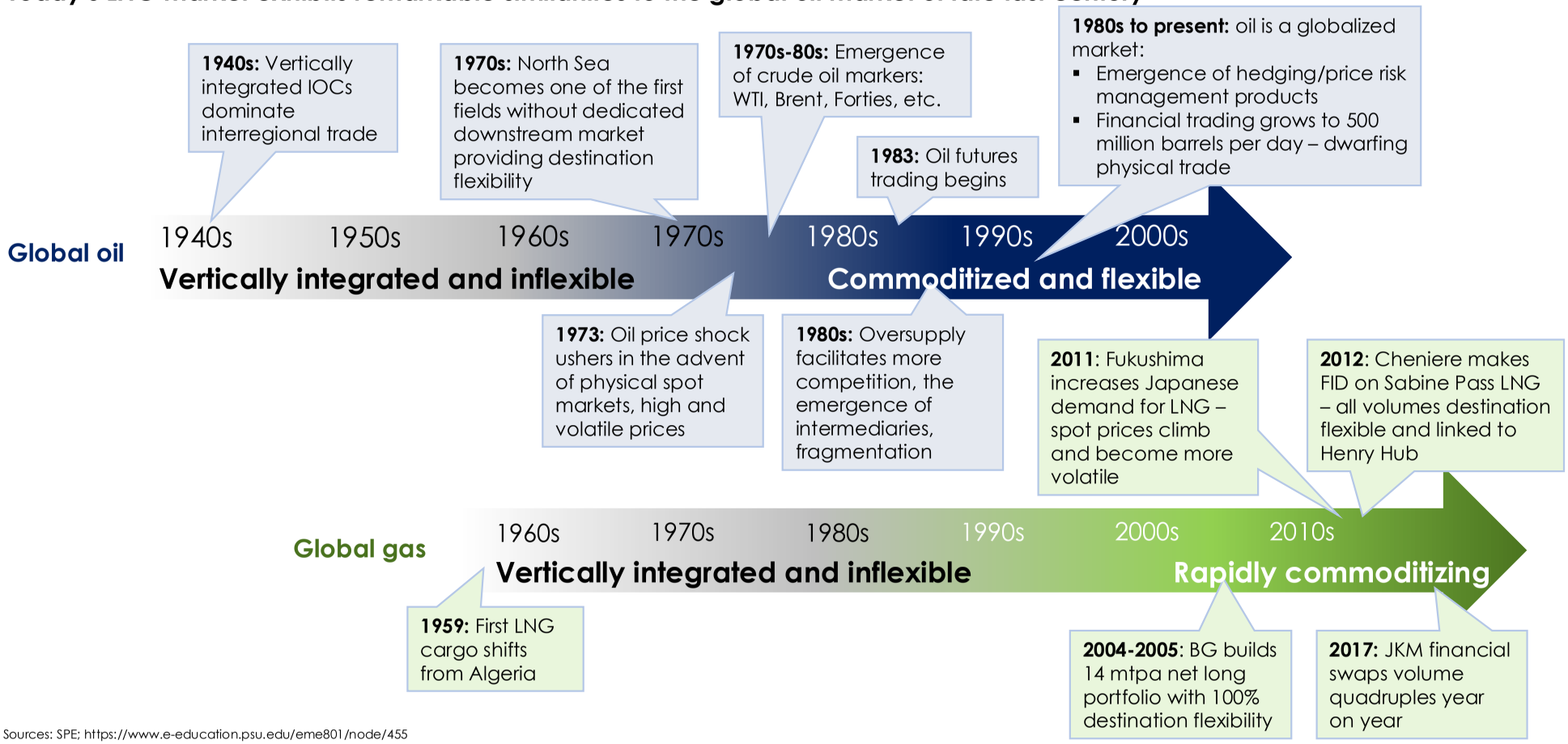
Global gas commoditizing

Today's LNG market exhibits remarkable similarities to the global oil market of late last century



Sources: SPE; https://www.e-education.psu.edu/eme801/node/455

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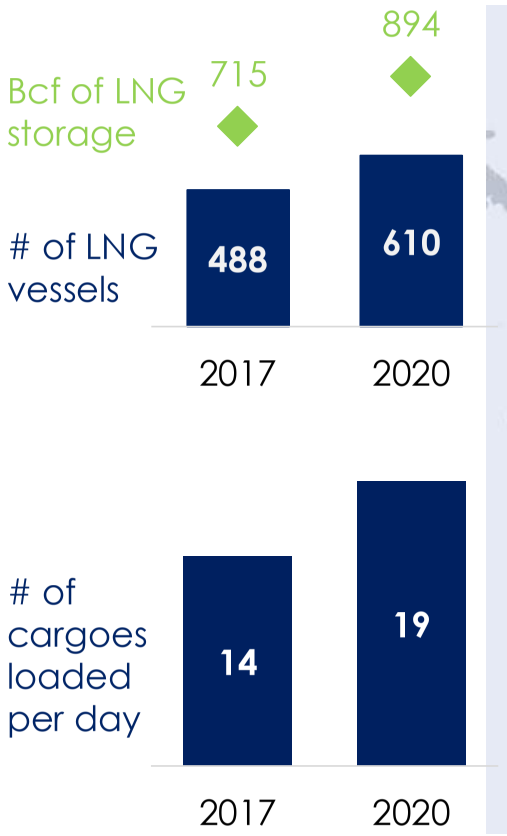
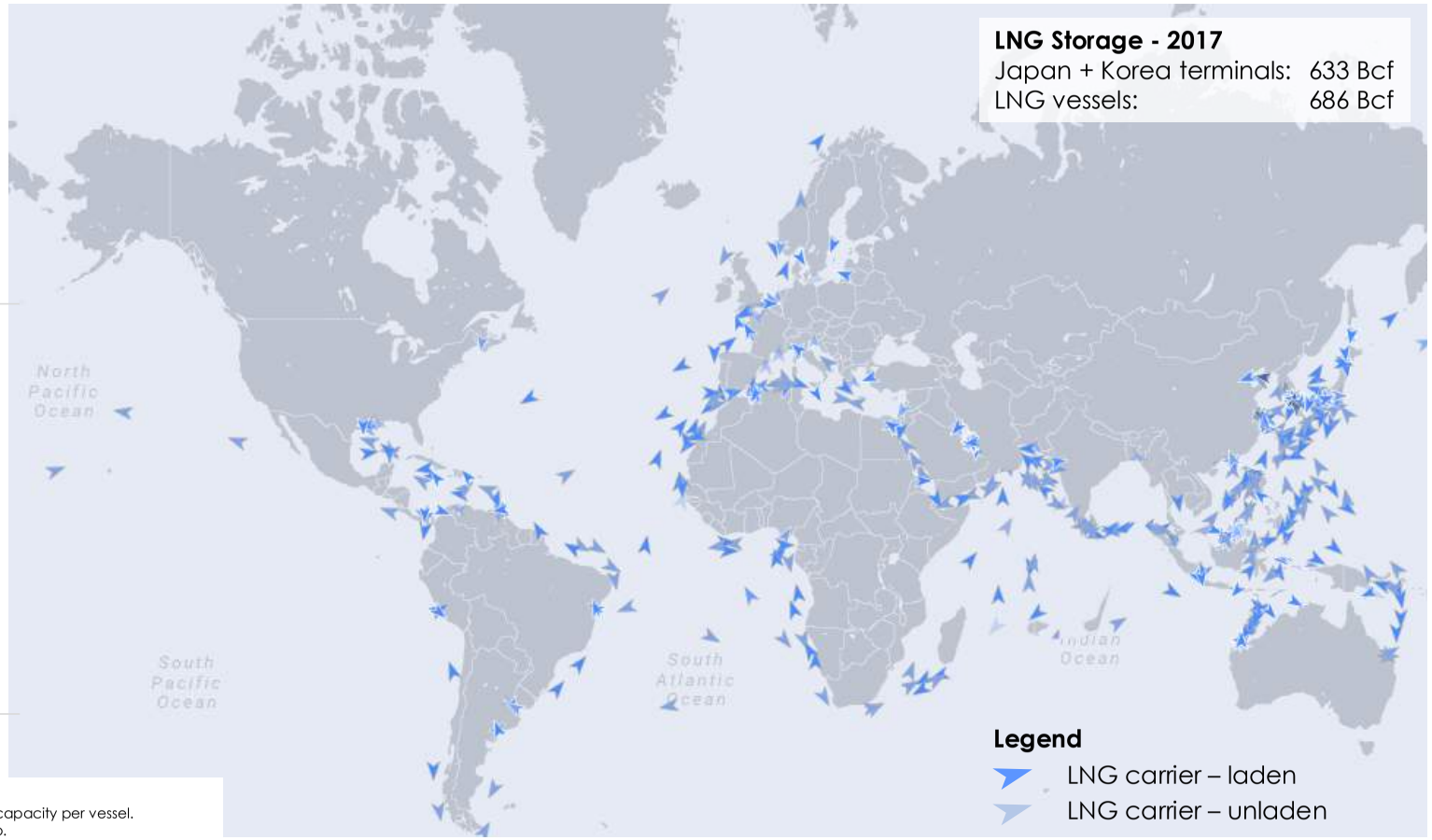
Daily LNG supply readily available across the globe





Sources: Kpler, Maran Gas, IHS, Wood Mackenzie.
Notes: LNG storage assumes half of fleet is in ballast, 2.9 Bcf capacity per vessel.
Average cargo size ~2.9 Bcf, assuming 150,000 m^3 ship.
In 2017, approximately a third of all LNG cargoes are estimated to be spot volumes.
Assumes 12% per annum demand growth.

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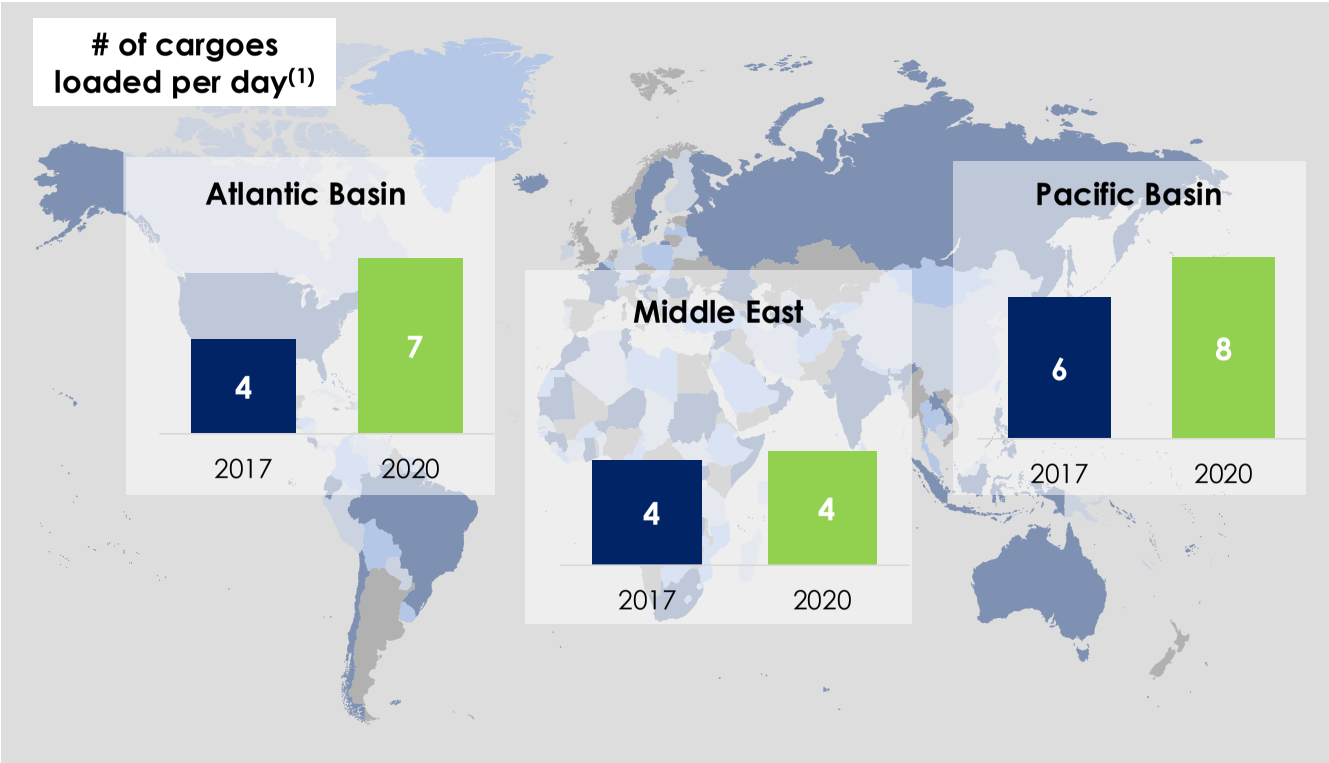
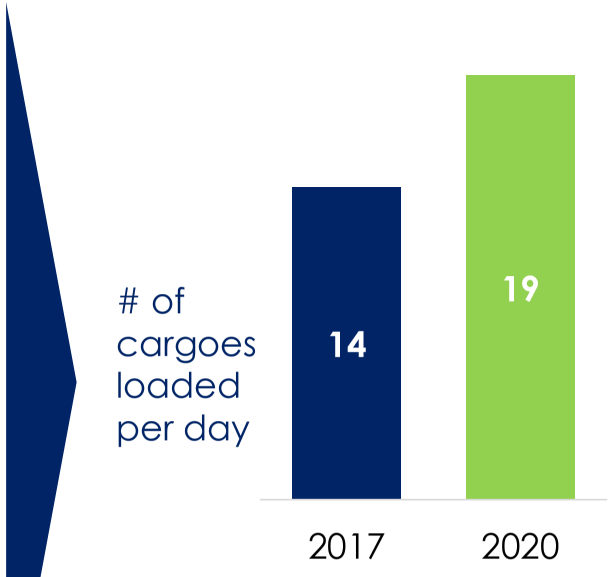
Growing LNG supply availability in all regions

By region



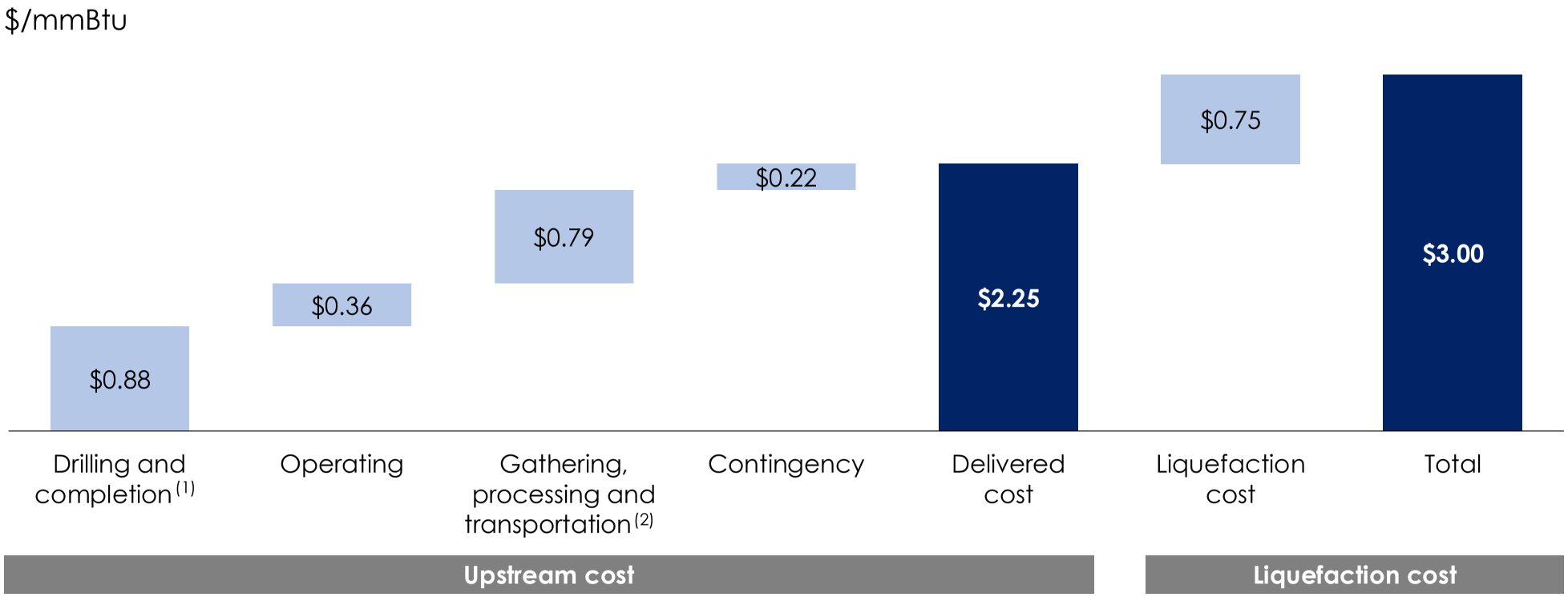
Globally



Source: Wood Mackenzie, Tellurian Research.
Notes: (1) one cargo represents ~3 Bcf of LNG

Driftwood Holdings' operating costs

Total anticipated cost of ~$3/mmBtu locks in low cost of supply



Sources: Wood Mackenzie, Tellurian Research.
Notes: (1) Drilling and completion based on well cost of $10.2 million, 15.5 Bcf EUR, and 75.00% net revenue interest ("NRI") (8/8ths).
(2) Gathering, processing and transportation includes transportation cost to Driftwood pipeline to market.

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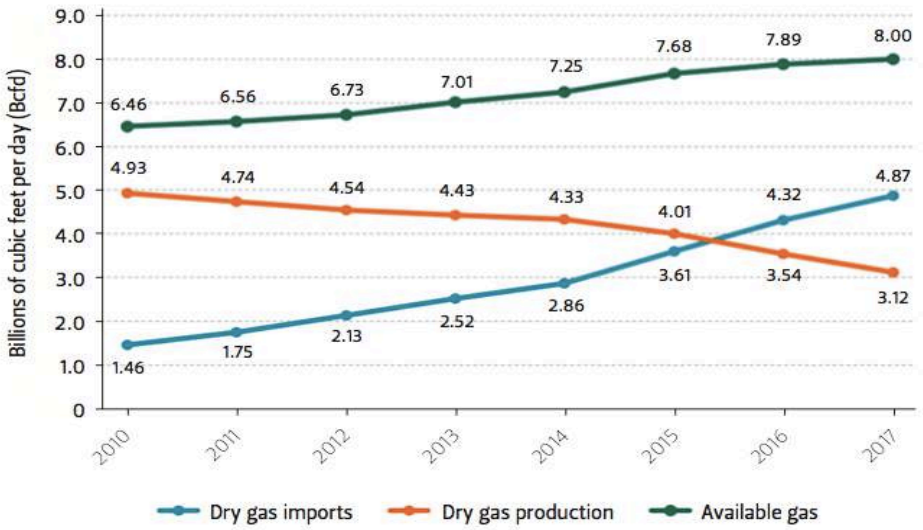
Mexico's Demand Risks:
Amid an Evolving Energy Landscape

Emily E. Medina

Energy Reform: Mexico's energy transformation

The main objectives of the energy reform are to transform the natural gas model to enhance energy security, promote infrastructure development and open access to producers and users, and provide for competitive gas pricing.

FIGURE 1 — MEXICO'S IMPORTS AND PRODUCTION OF DRY NATURAL GAS (2010–2017)



NOTE Data for 2017 were only available for January to October.

SOURCE Mexico's National Hydrocarbons Commission, https://portal.cnih.cnh.gob.mx/downloads/es_MX/estadisticas/Balance Gas Natural.pdf

A brief history of PEMEX

- PEMEX was created in 1938 by then-Mexican President Lazaro Cardenas
- National symbol
- Decline on PEMEX's productivity

The creation of the energy reform

- Approved in December 2013 and passed secondary legislation in August 2014
- Open energy sector (exploration, and production) to domestic and foreign private companies

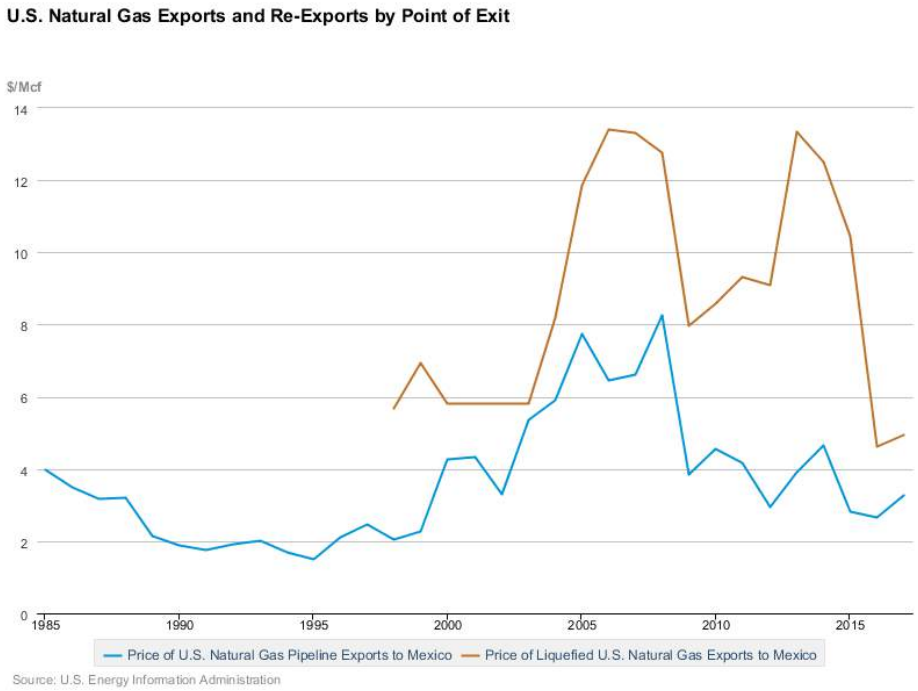
Objectives of the energy reform

- Transform natural gas model to enhance energy security
- Promote infrastructure development
- Open access to producers and users and provide for competitive gas pricing

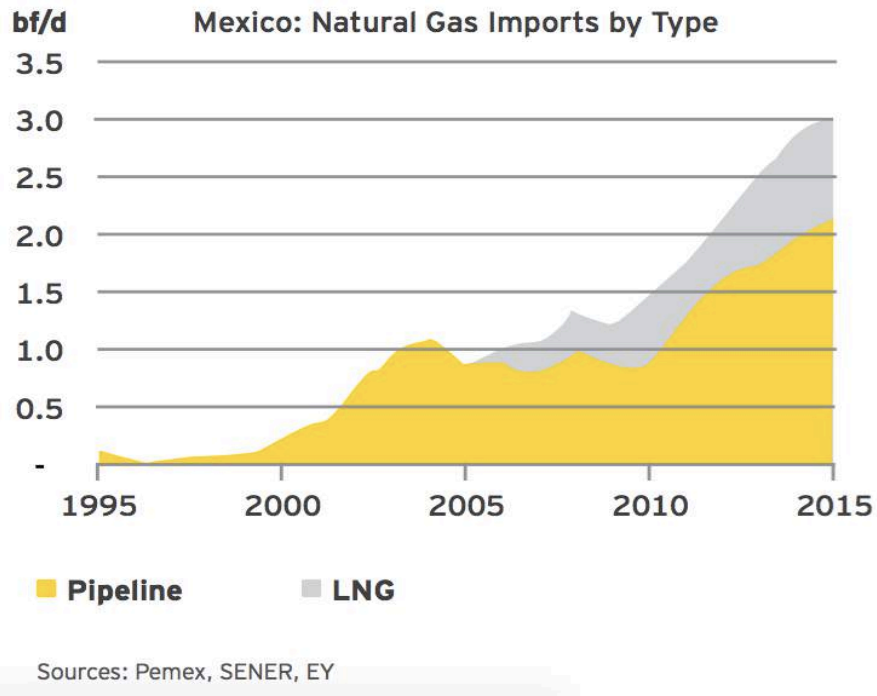
Energy trade between Mexico and the US

Mexico is the United States' second-largest export market (after Canada) and third-largest trading partner (after Canada and China). In 2017, two-way trade in goods and services totaled $623 billion.

Natural gas exports to Mexico from the United States were 4.6 Bcf/d in 2017.

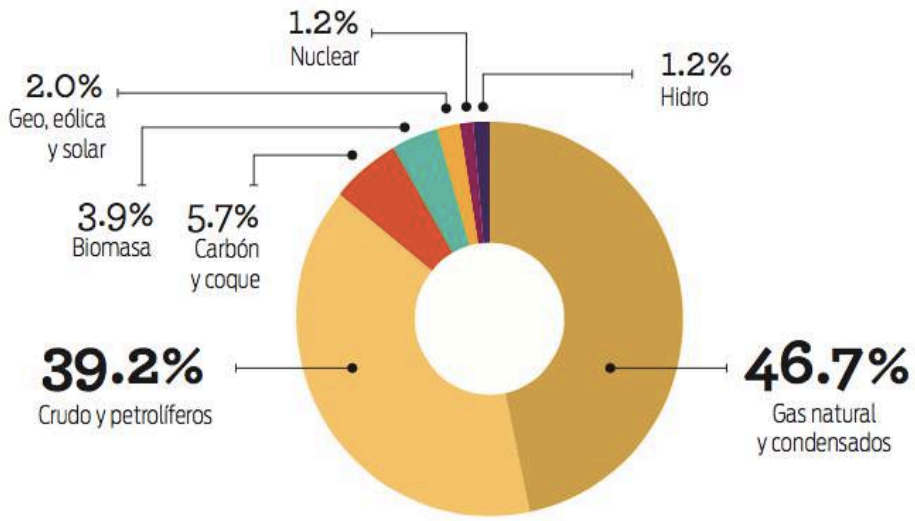


Mexico accounts for 60% of U.S. gasoline exports....and 65% of U.S. natural gas exports.



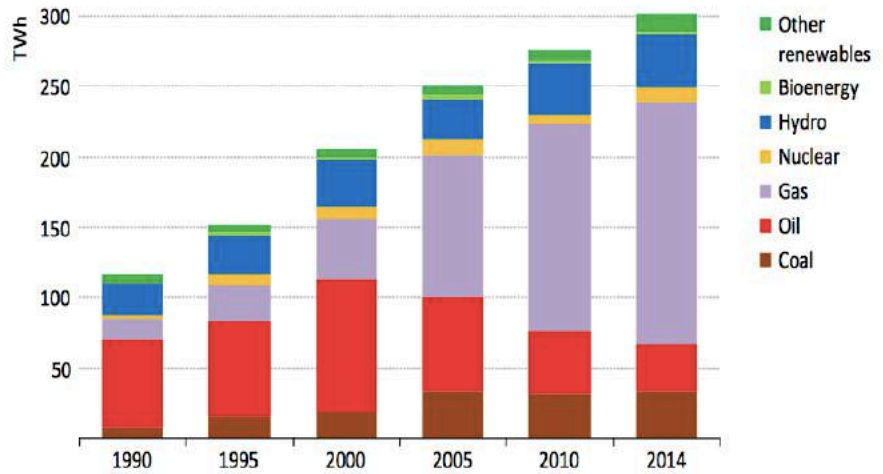
Overview of Mexico's energy mix

Mexico has significantly increased natural gas imports from the US driving an oil-to-gas fuel switch in the power sector, which is helping the country meet its GHG emission reduction targets.



Fuente: Sistema de Información Energética, Sener.

Figure 1.4 ▷ **Electricity generation by fuel**



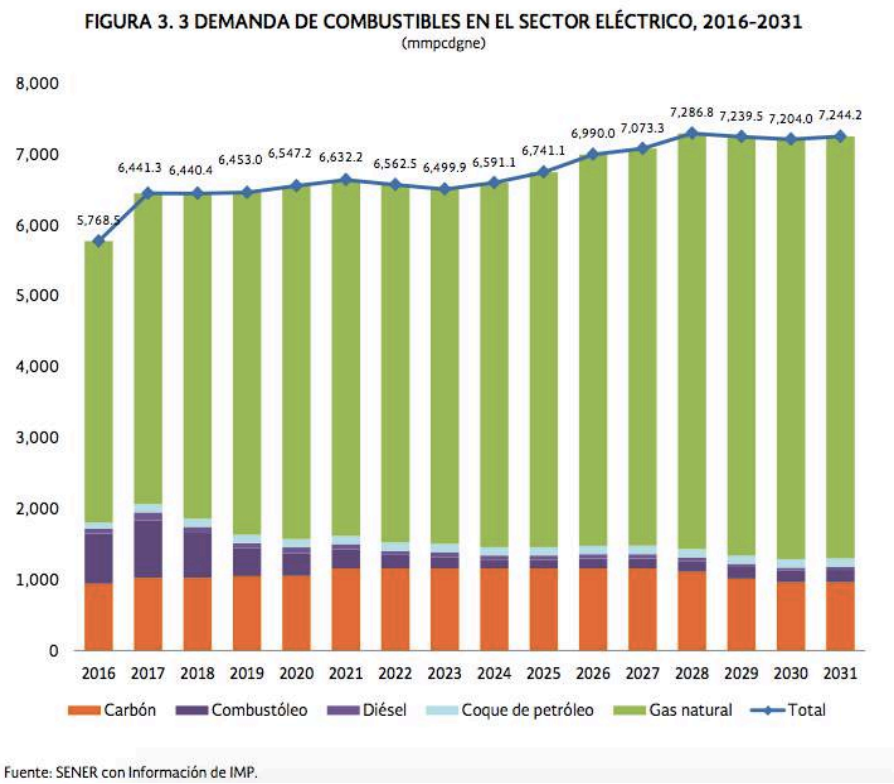
Electricity generation in Mexico has more than doubled since 1990 and diversified away from a costly reliance on oil

Notes: TWh = terawatt-hours. Other renewables include geothermal, solar PV and wind.

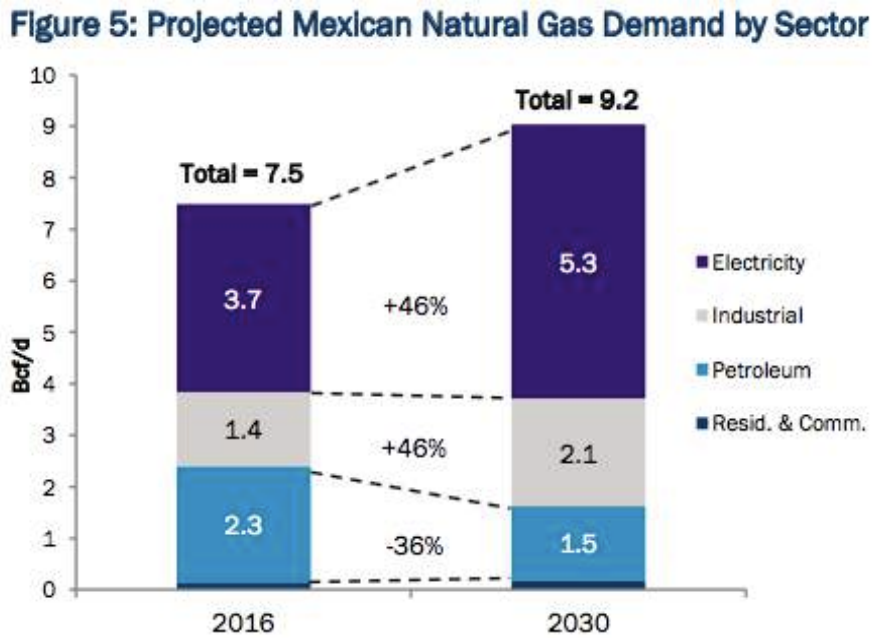
Source: EIA, Mexico energy outlook 2016

Factors driving natural gas demand

Natural gas in Mexico has been and will continue to be in demand. The Ministry of Energy's projects, a 3.8 percent increase in average annual demand for the next 14 years due to electricity generation demand.



Fuente: SENER con Información de IMP.

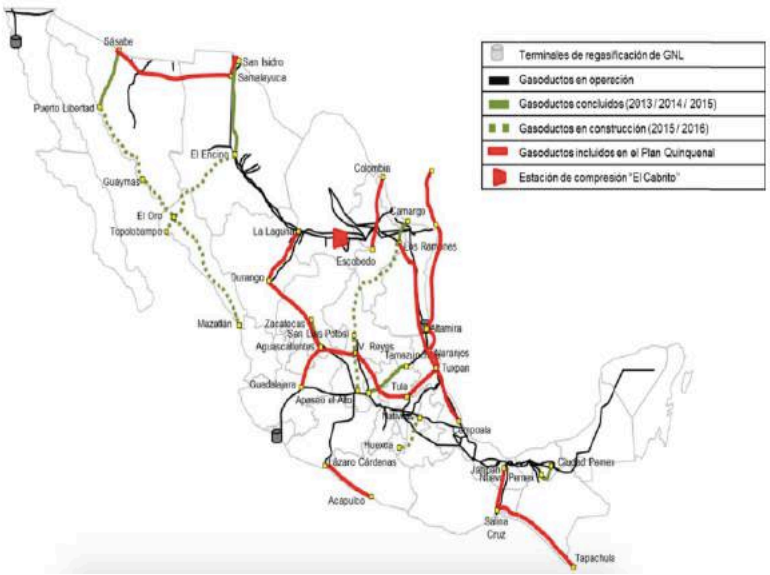


Sources: SENER Prospectiva de Gas Natural, FTI Analysis
Note: Resid. & Comm in 2016 is 0.1 Bcf/d and in 2030 is 0.2 Bcf/d

Mexico’s midstream build-out

Mexico’s domestic pipeline network expansion plan, includes 12 additional pipelines (3,200 miles) with a total capacity of 9.7 Bcf/d.

Anexo 1. Mapa del Plan Quinquenal de Expansión del Sistema de Transporte y Almacenamiento Nacional Integrado de Gas Natural 2015-2019



- SISTRAGAS, operated by CENAGAS, is the largest transportation system in Mexico accounting for 10,068km.
- Comisión Federal de Electricidad (CFE) has a total of 4,495 km of pipelines under construction.
- The CRE is creating a transparent and price transparent market.
- On June 16, 2017 it removed the price cap that PEMEX could charge for natural gas.
- PEMEX is required to release 70% of the volume of its gas supply portfolio.

Main risks facing Mexico's natural gas projects

- Political situation, Mexico's presidential elections
  - AMLO, frontrunner in polls Left-wing party MORENA, (National Regeneration Movement)
  - NAFTA
  - Nationalist views
  - Cut on energy imports
  - Increase in Mexico's domestic natural gas production
- Land rights
  - Process of mediation and *consulta previa*
  - Irregularity in land titles
  - CRE's requirements do not match Mexico's reality
- Security concerns
  - Violence most prominent around shale oil and gas reserves
  - Stiffening of fuel in pipelines by non-state actors
  - Infrastructure build-out challenged by non-state actors

Opportunities for the US in Mexico's midstream build-out

Source: EIA

"Mexico's success will mean American success, particularly for those who see real value in securing North American energy independence"- Meghan L. O'sullivan.

- Access to Mexico's liberalized energy market
- Mexico's demand growth over the next decade
- Favorable geography and logistics
- The realization of North American energy independence is to some degree dependent on the success of Mexico's energy reform going forward.

Understanding the Future Evolution of Asian Gas Markets: China and India

Growing the American Natural Gas Production Platform
EPRINC Workshop

Ashutosh Shastri, EnerStrat Consulting, UK
Lucian Pugliaresi, EPRINC

April 19th 2018
Washington DC, USA

HISTORICAL PROGRESSION OF THE CHINESE OIL & GAS INDUSTRY

Today

1949-1959

5th Division of 19th PLA Army formed into an "Oil Corps"

Oil Self sufficiency viewed as critical to national security

Ministry of Petroleum Industry formed in 1955

China Imports Oil products from Russia

Regional Petroleum Administration Bureaus formed

Oil & Gas production picks up but relations with Russia start to strain

1960-1978

5th Division of 19th PLA Army formed into an "Oil Corps"

Oil Self sufficiency viewed as critical to national security

Ministry of Petroleum Industry formed in 1955

China Imports Oil products from Russia

Regional Petroleum Administration Bureaus formed

Oil & Gas production picks up but relations with Russia start to strain

1979-1991

China launches its economic liberalisation policy (1978)

PAB -Big Contract Regime Starts (1981)

MPI abolished and CNPC formed (1988)

Production matures

Oil imports rise

PABs become legal entities and de-centralisation experiment starts

1992-1998

PAB de-centralisation recognised as a "management disaster" (1995)

Price rationalisation to align with international oil prices

Industry losses balloon, productivity drops and imports rise

1998-2008

Big bang industry reform (1998)

Petroleum industry equated to National Security

Re-centralisation through asset swaps

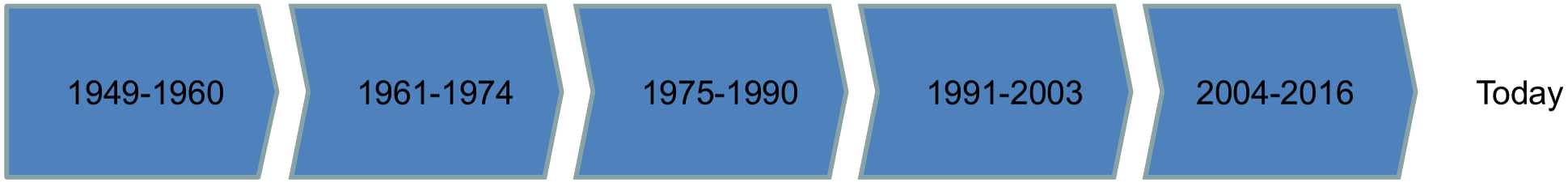
CNPC, Sinopec Group and PetroChina are created (1999)

Growth in international activity

A bipolar CNPC begins to take shape

Source: EnerStrat Analysis

HISTORICAL PROGRESSION: INDIAN OIL & GAS INDUSTRY



1949-1960

Oil Fields Act 1948

Petroleum and Natural Gas Rules 1959

Formation of ONGC

Russian Technical Cooperation Programme starts

Conflicts with former imperial companies rise due to concerns of monopolies

Petroleum industry and national security get equated.

1961-1974

IOC xenophobia begins to take shape on the back of monopolies concerns and the Iran Coup of 1952

GoI starts to take steps for nationalisation of petroleum industry

IOCL is created as a national marketing company

1973 Oil crises shapes the debate on strategic security, suspicion of foreign companies heightened.

1975-1990

New National companies are created from the oil industry nationalisation initiative

1974: Oil Industry Development Board
1976: BPCl
1974: HPCL
1984: GAIL
1988: Petronet LNG

IOCs exit India

A period called "the golden age of national companies" begins, ONGC leads the pack.

1991-2003

Balance of Payment Crises in India (1991)

Economic Liberalisation Policy announced (1991)

DGH as an "upstream regulator" is created 1993

NELP rounds for private sector participation announced (1993)

First LNG deal is signed with Qatar (2002)

2004-2016

First LNG arrives in 2005

New gas discoveries in D6

The Reliance PSC saga plays out

The LNG and Pipelines infrastructure starts to pick (2010)

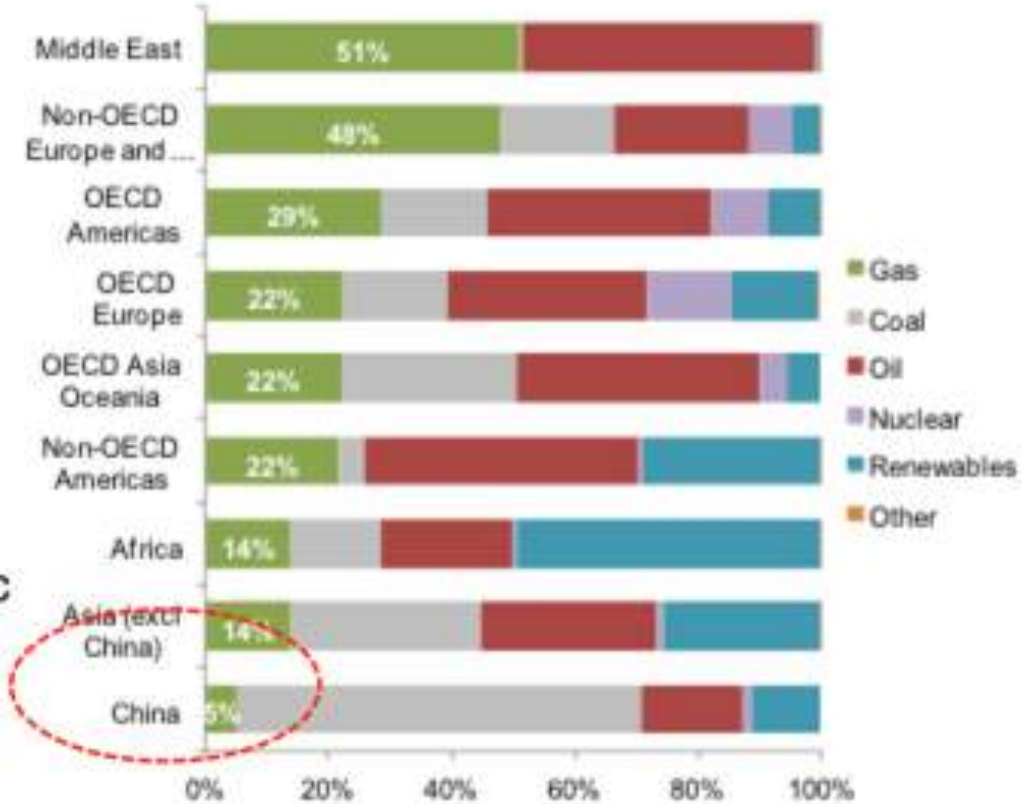
Source: EnerStrat Analysis

Growing significance of "gasification" in Asia

- Asia will experience the fastest energy demand growth in the world, and has a significant potential of energy switch to natural gas.

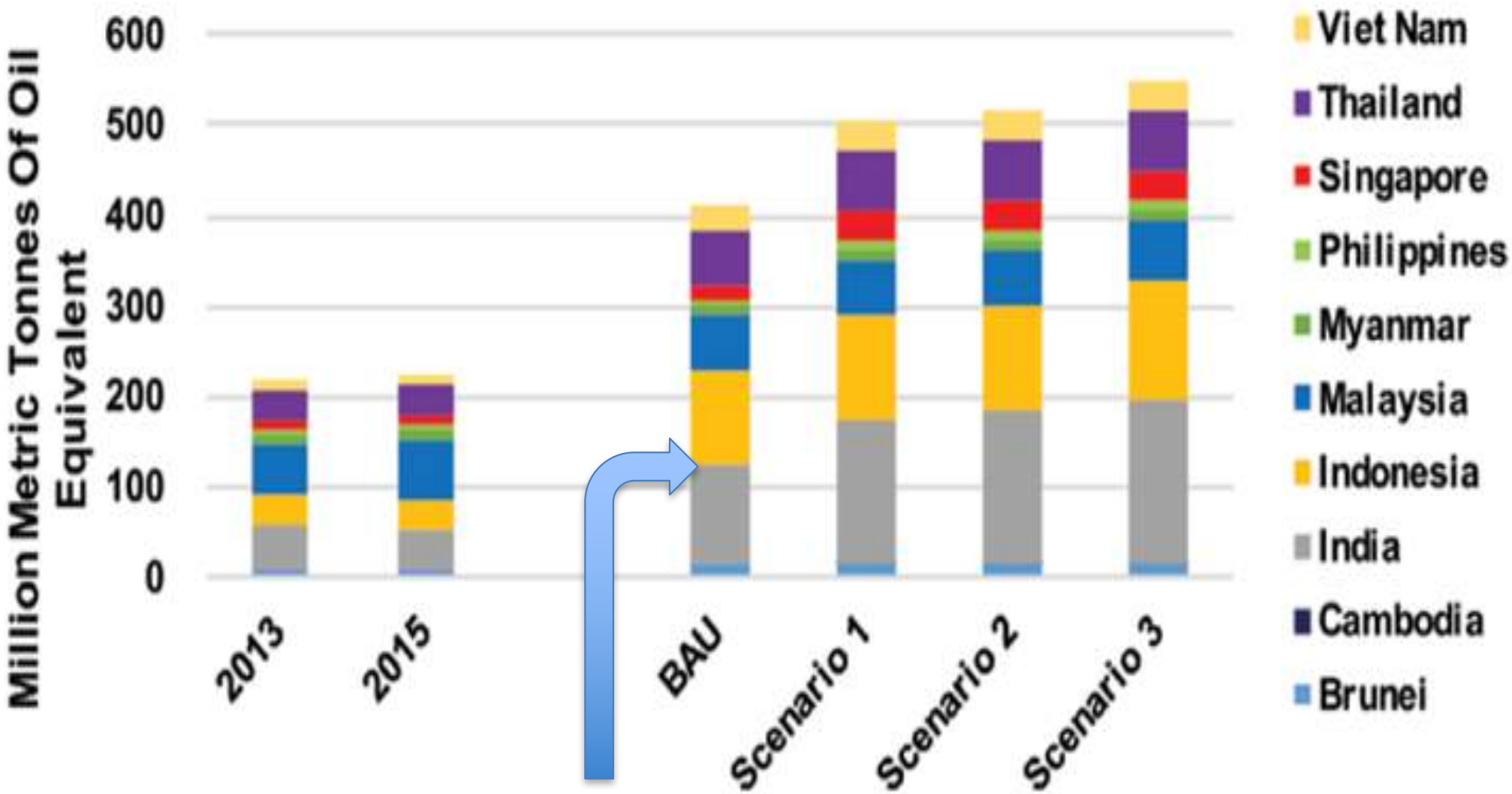
- Natural gas contributes to **4**Es of Asia.
  - Equity: Reduced need for fuel collection, women's participation to social and economic activities, children's enrollment of school, etc.
  - Environment: GHG emissions reduction, improvement of air quality
  - Energy security: Diversification of energy sources and geographical supply sources
  - Economic competitiveness: Economic alternative to oil products though less competitive than coal or subsidized renewable energy.

Energy mix by region



Source: IEEJ – EPRINC "Future of Asian LNG" 2017

Asean + India – 100 MMT Range in 2030 Forecast



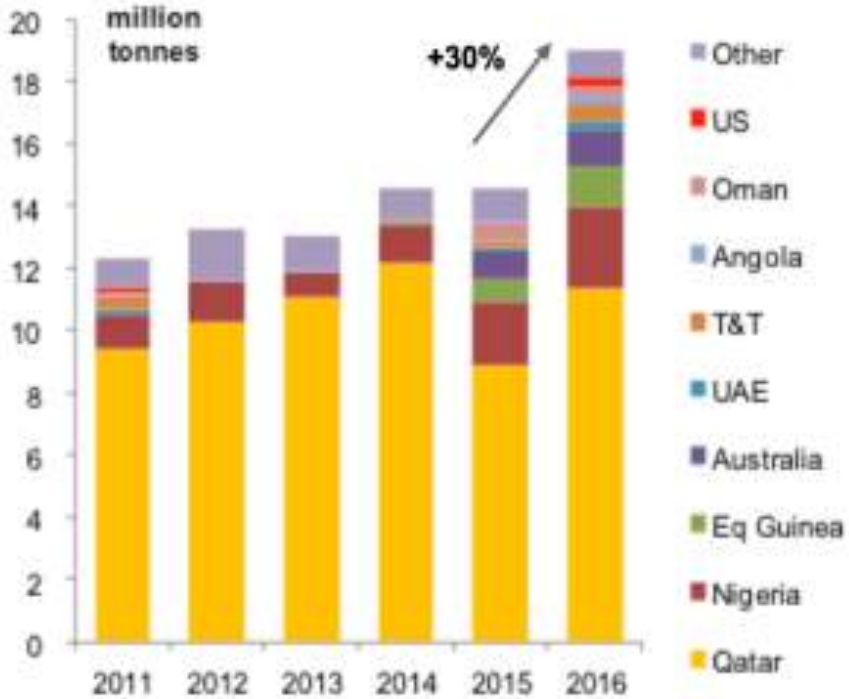
Most volume risk from India

Source: IEEJ – EPRINC "Future of Asian LNG" 2017

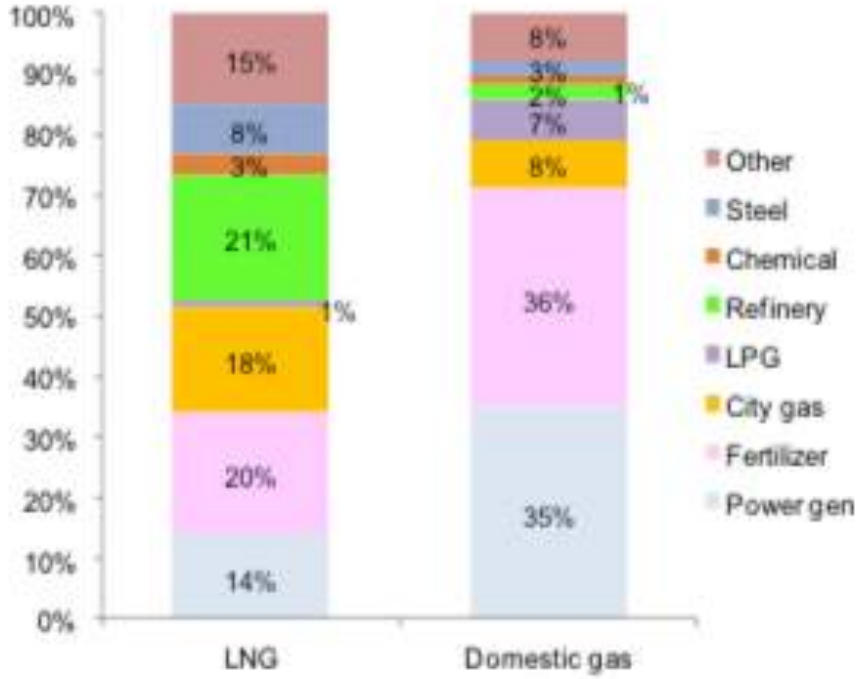
LNG demand in India

- LNG demand in India jumped up in 2016.
  - The share of long-term contract is reduced to almost half, and many of the incremental import was spot purchase.
- Major area of LNG use is refinery and industrial fuel.
  - LNG is still less competitive in power sector.

India's LNG import by country

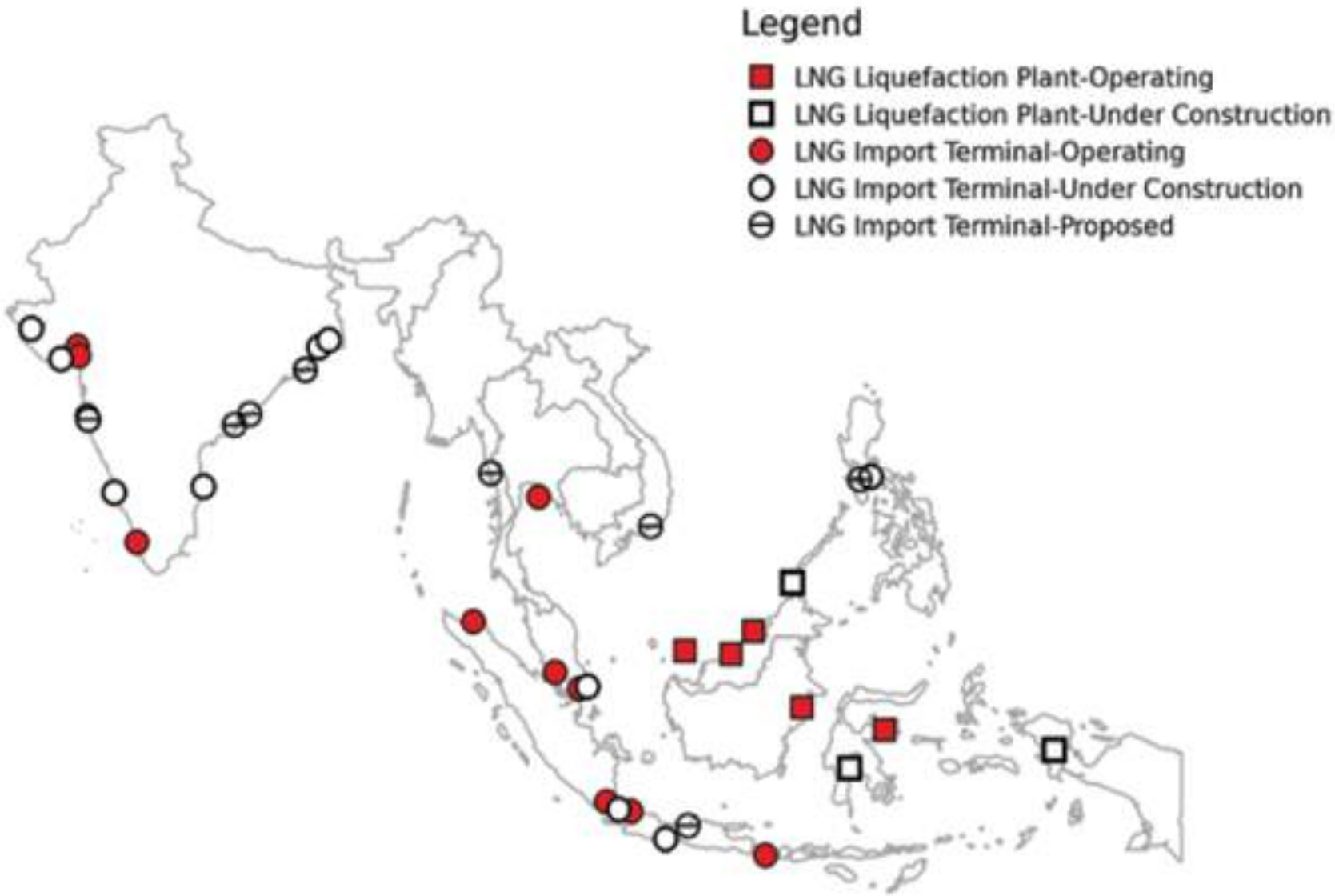


Use of LNG and India



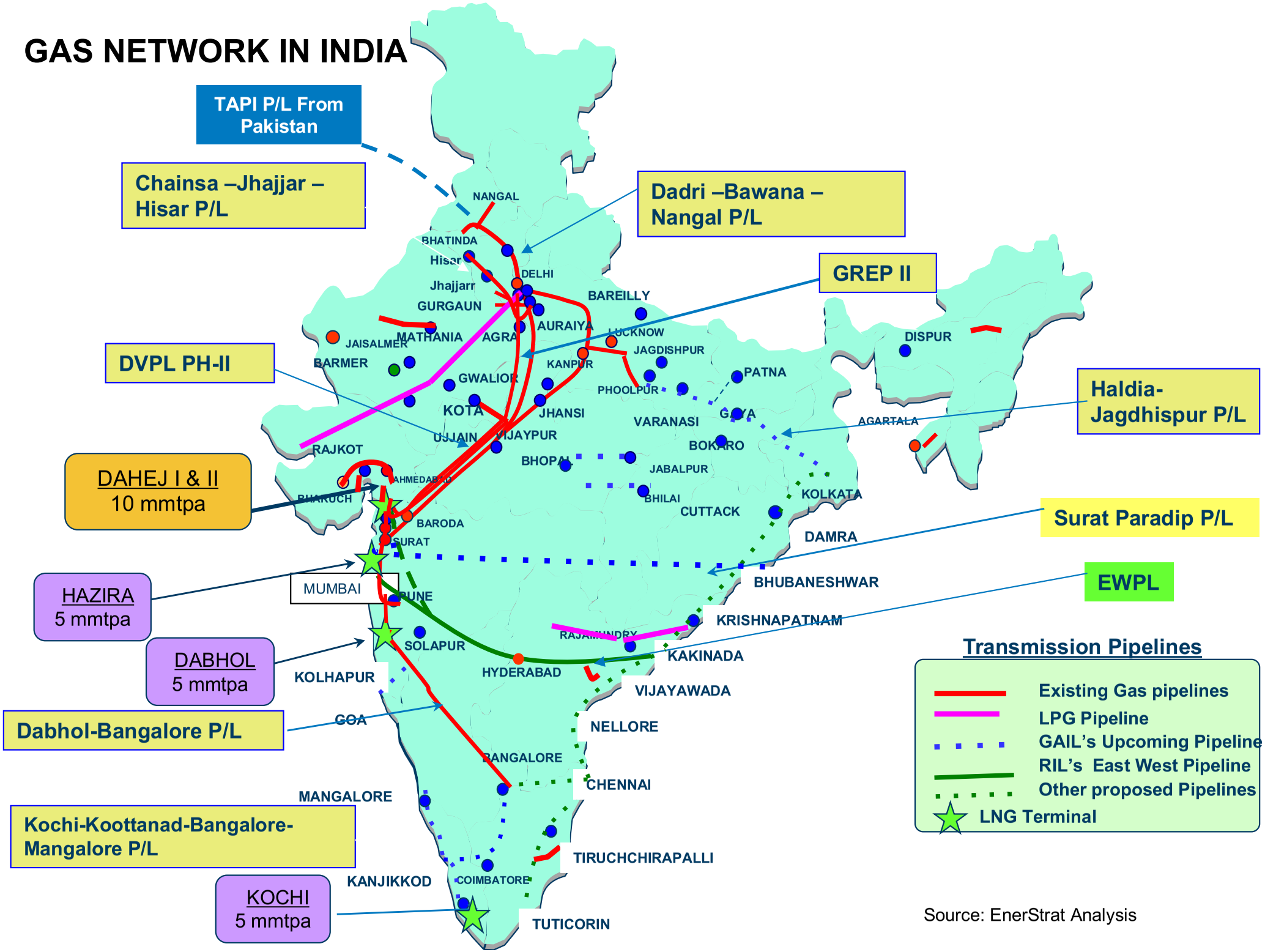
Source: IEEJ

ASEAN – LIQUEFACTION and REGAS Capacity -- 2017



Source: IEEJ – EPRINC "Future of Asian LNG" 2017

GAS NETWORK IN INDIA

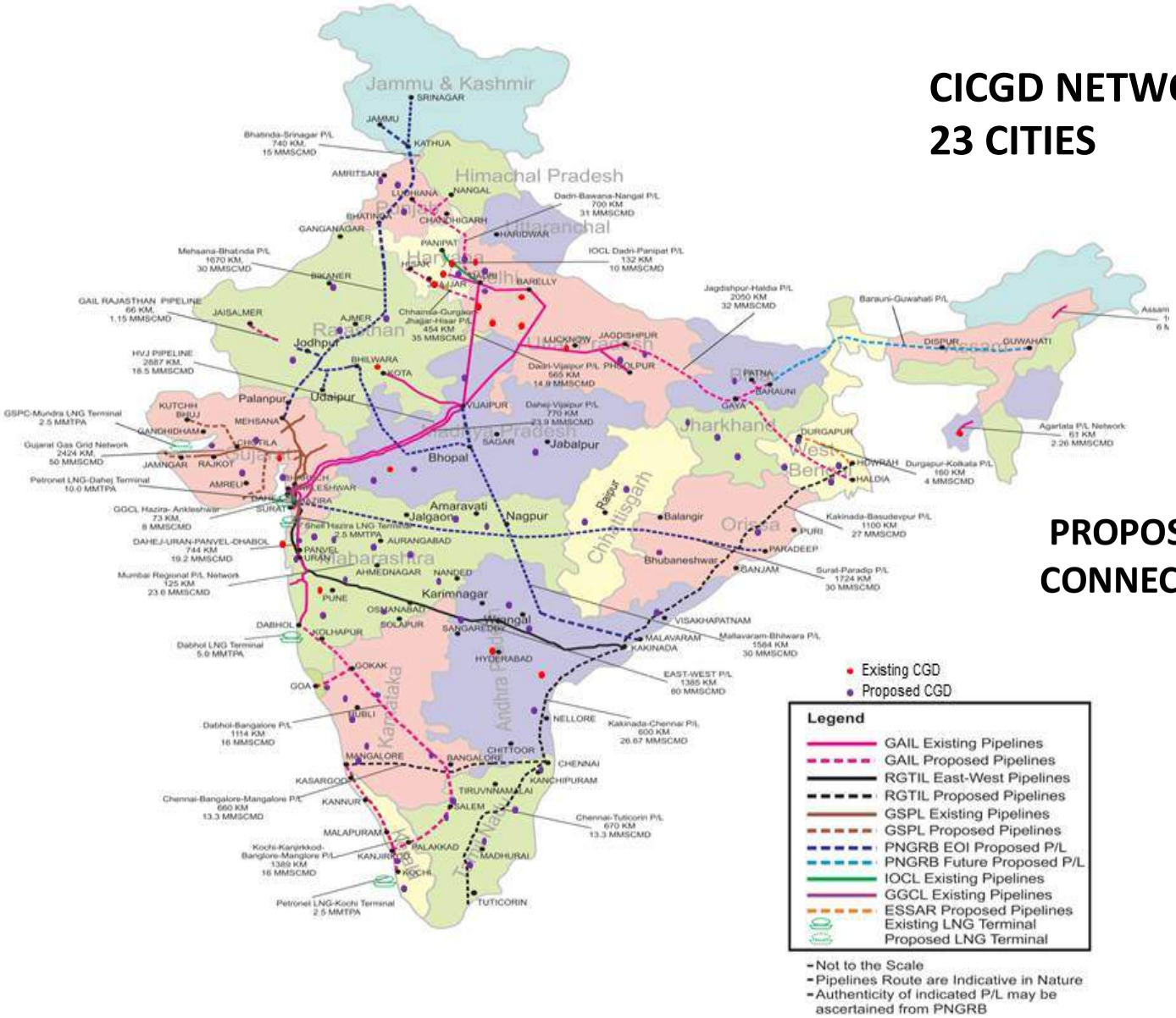


Source: EnerStrat Analysis

CGD NETWORK OF INDIA- THE NEXT WAVE

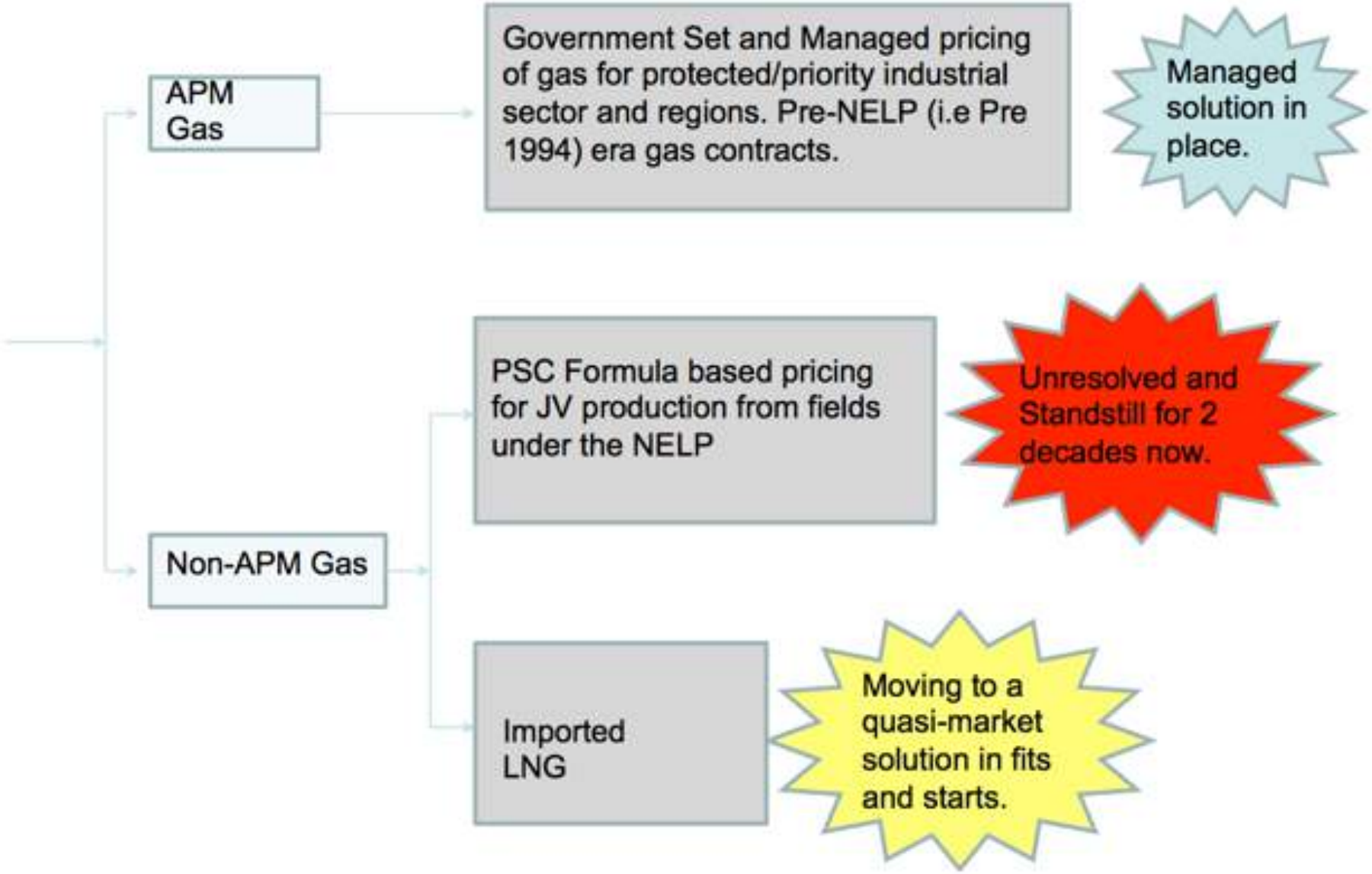
CICGD NETWORK – 23 CITIES

PROPOSED TO BE CONNECTED – 56 CITIES



Source: EnerStrat Analysis

UNDERSTANDING GAS PRICING IN INDIA

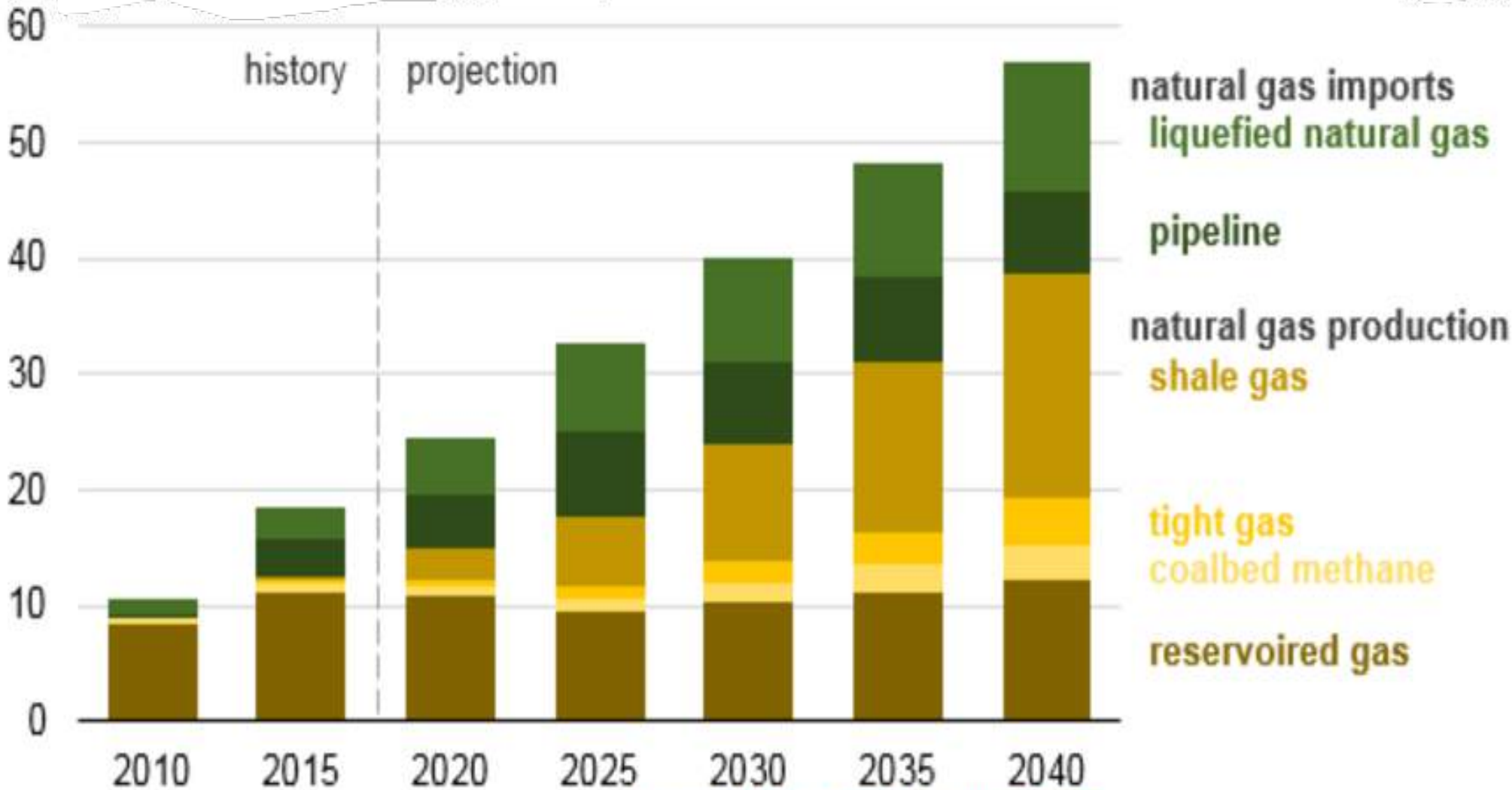


Source: EnerStrat Analysis

ENERSTRAT CONSULTING

CHINA GAS SUPPLY TO 2040 – EIA

(billions of cubic feet/day)

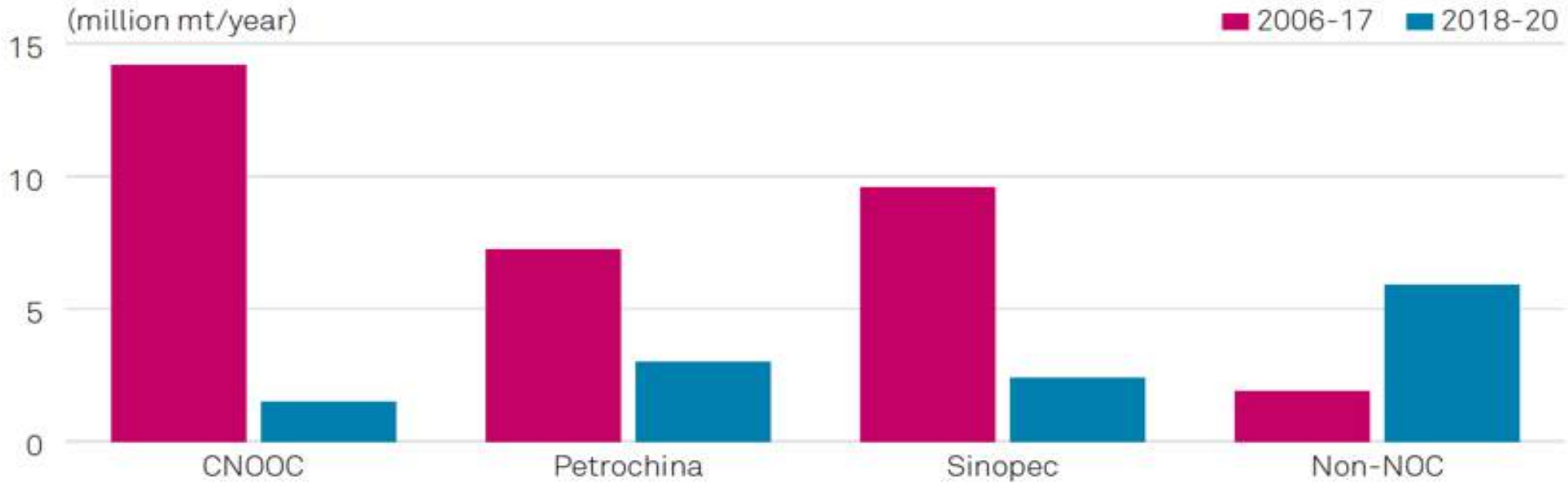


Source: U.S. Energy Information Administration, *International Energy Outlook 2017*, China Development and Reform Commission, China Customs

TERM CONTRACTS SIGNED BY INDEPENDENT ENTITIES SINCE 2015

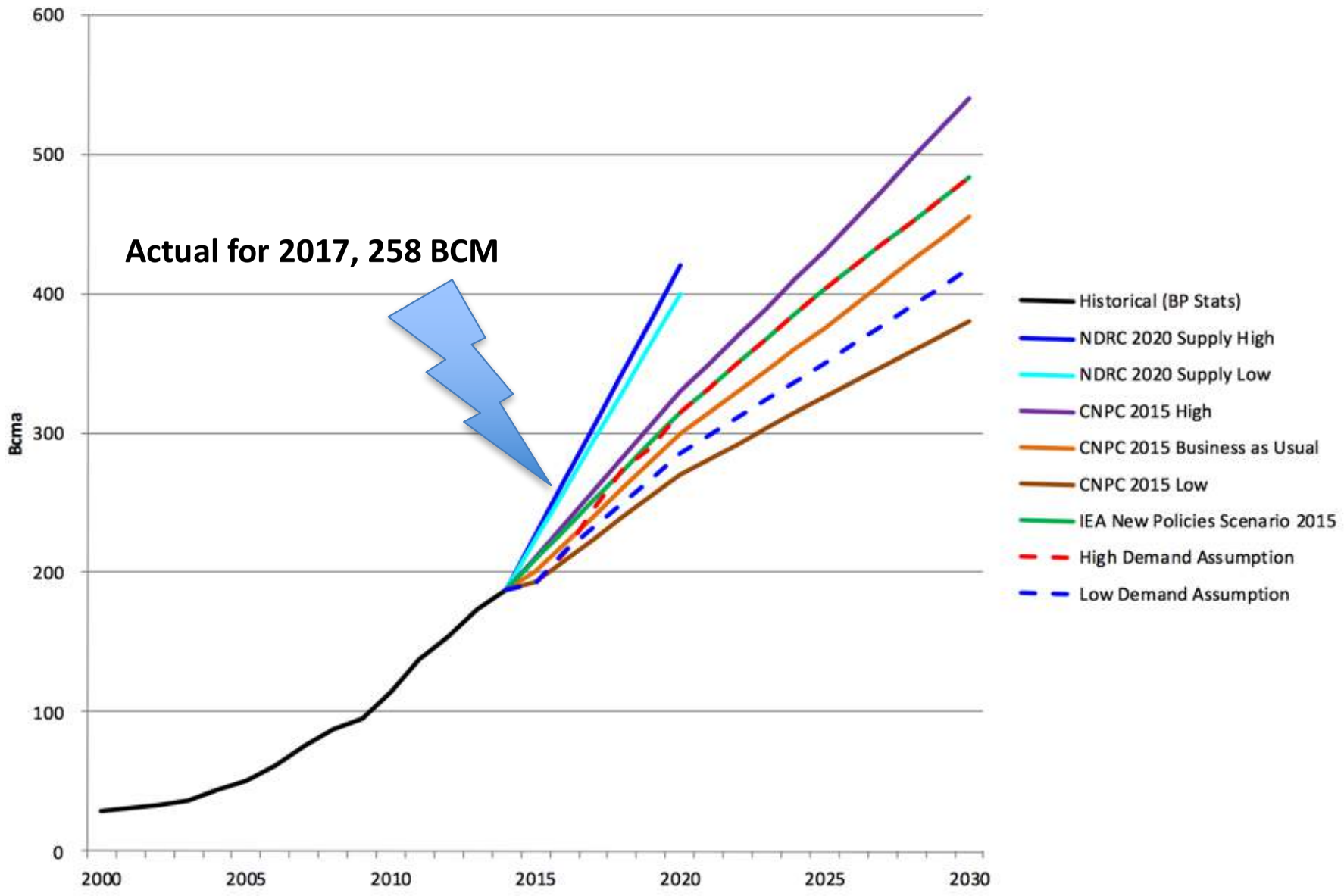
Buyer	Seller	Contract Type	Signing Year	Contract Start	Duration (years)	Volume (million mt/year)
ENN	Chevron	SPA	2016	2018	10	0.65
ENN	Total	HOA	2016	2018	10	0.5
ENN	Origin	SPA	2016	2018	5	0.28
Guangzhou Gas	Woodfibre LNG	HOA	2016	2020	25	1
Huadian	BP	SPA	2015	2020	20	1
Huadian	Chevron	HOA	2015	2020	10	1
JOVO	Petronas	SPA	2016	2017	6	0.7
JOVO	Chevron	Key Terms Agreement	2016	2018	10	0.5

CHINA CONTRACTED VOLUMES BY BUYER



Source: S&P Global Platts

China Historical and Future Natural Gas Demand from Various Sources



Source: Howard Rogers, OIES, various sources, 2015 forecast

CHINA & INDIA: SIMILARITIES AND DIFFERENCES

Key Similarities

Petroleum and Gas sectors in both countries are viewed as “victims” of the mixed economy model- the no man's land between planned/centralised government dominated industry and a free market economy.

Both countries have challenges of managing high economic growth, high population, dangerous air quality issues, lack of politically independent institutions and issues of policy transparency

Both countries are keen to reduce consumption of high emission fossil fuels, develop renewable energy systems and face domestic pressures to act.

Both countries posit themselves as large consumers of clean burning natural gas- both are “talking the talk”

Both countries have plans to develop their own unconventional resources.

Key Differences

Important differences in industry structure: while China has vertically integrated regional monopoly structures, India has specialised and nationally operating monopoly structures.

Big differences on the urgency for developing gas fired electricity generation capacities: While China is signalling a clear intent to shift coal fired generation to gas and at scale- such signals are not palpable in India.

Large industrials in China are emerging as direct international buyers whereas Indian state owned entities are playing role of demand aggregators.

Important differences in the operational style of policy makers in both countries; especially while Chinese institutions appear reticent to openly discuss [pricing reform the Indian institutions appear to be open to discussion.

China with significant international pipeline interconnection systems has the opportunity to play off pipeline gas and LNG, India will be a LNG driven play.

Source: EnerStrat Analysis

METI
Ministry of Economy, Trade and Industry

LNG market in South East/South Asia & US-Japan Energy/Infrastructure Cooperation

April 2018

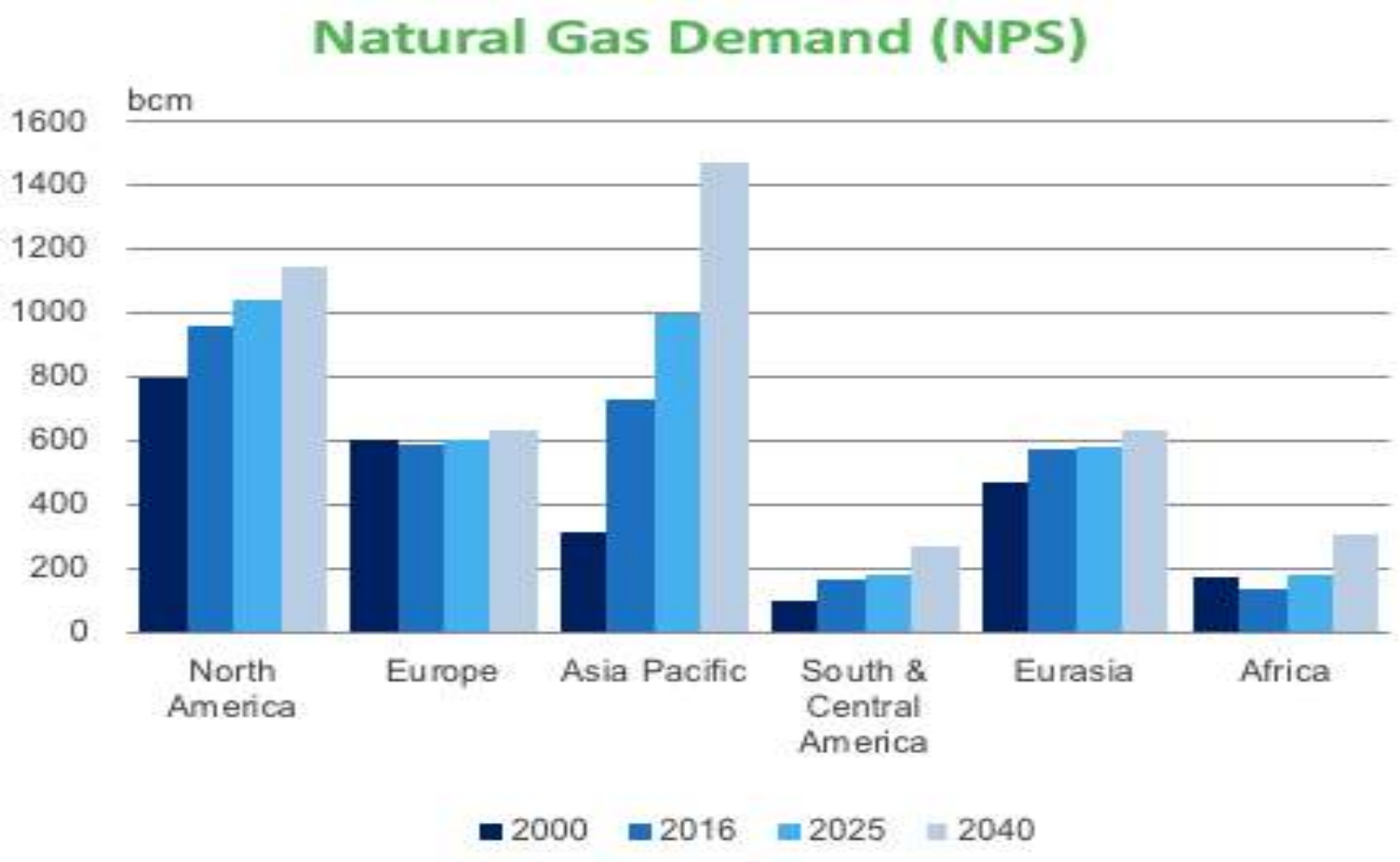
Takeshi SODA

Special Advisor

Ministry of Economy, Trade & Industry (METI), JAPAN

Natural Gas Demand in the world

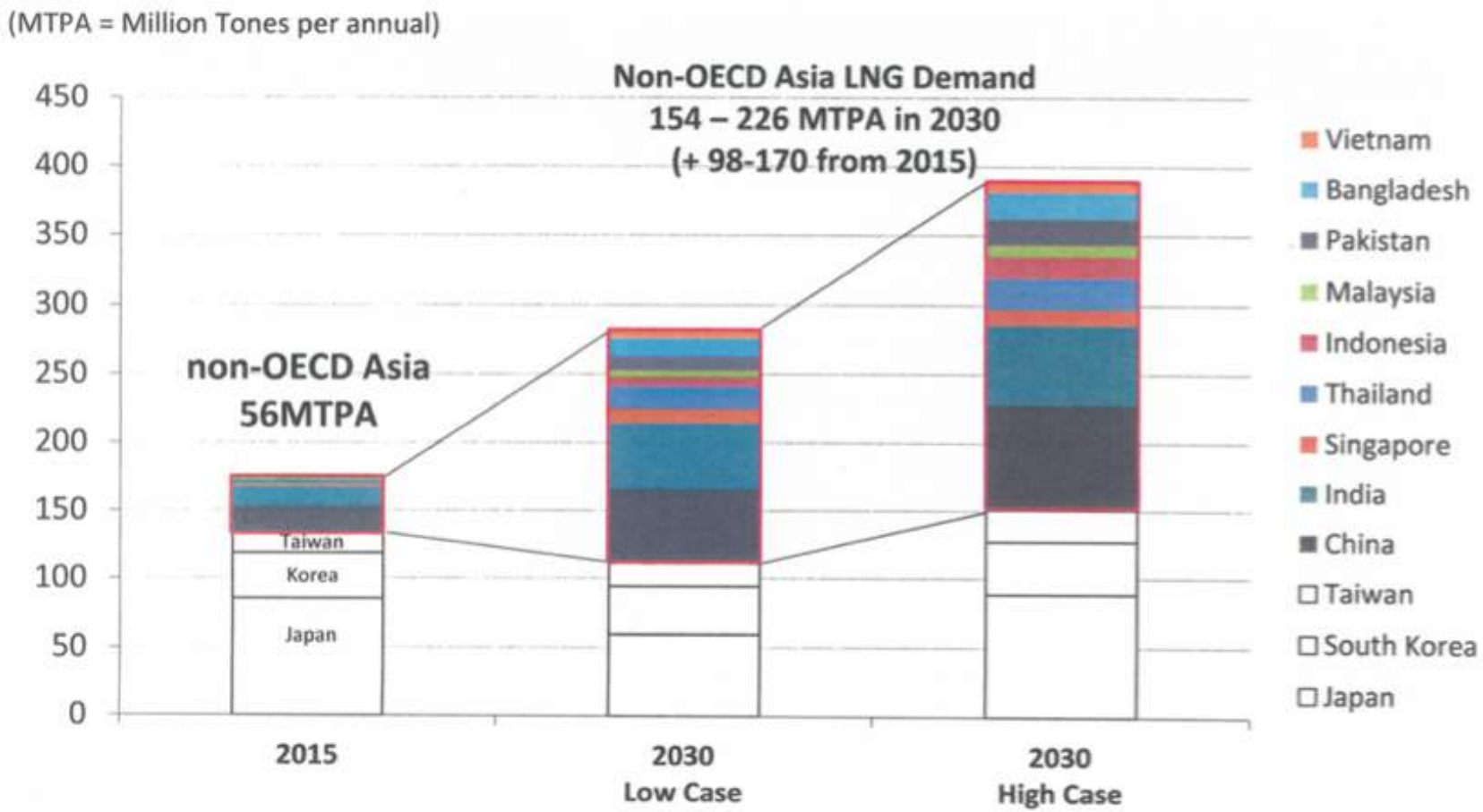
- Asia accounts for most of current consumption growth and will be at **the center of the natural gas market growth**.



IEA/Natural Gas Market Update(2018)

LNG Demand for Asian region

- LNG demand for Non-OECD Asian region in 2030 is expected to be **3 to 4 times** more than it was in 2015

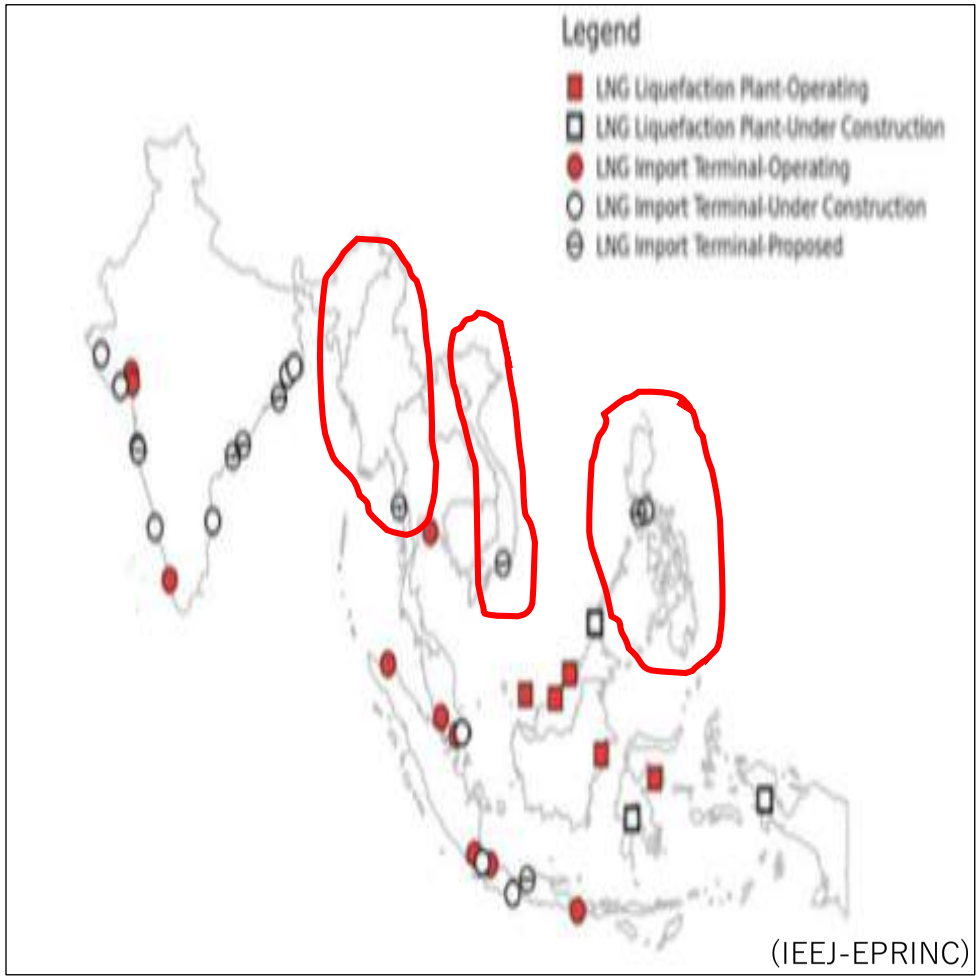


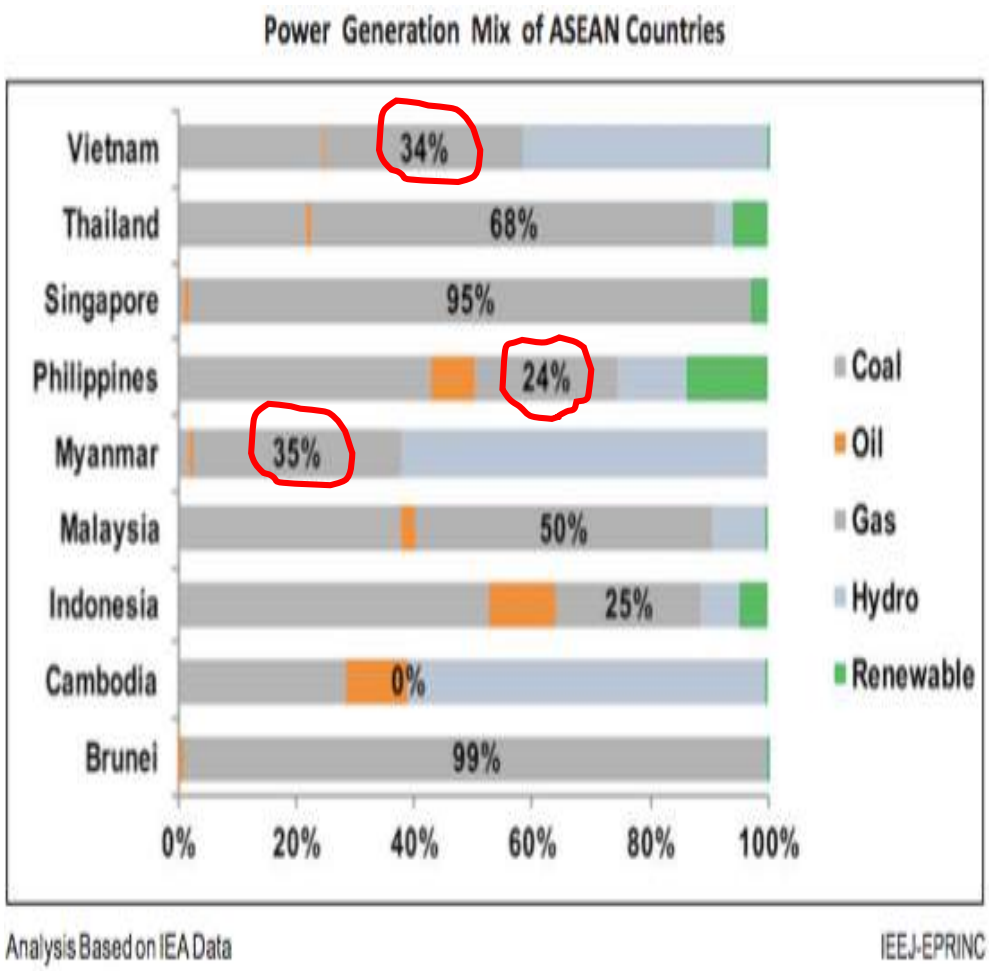
Source : The Oxford Institute for Energy Studies, LNG Market "The great recofiguration" (Released in October 2016)

LNG market potential in South East / South Asia ①

- **Phillippines**
- **Vietnam**
- **Myanmar**
- **Sri Lanka**

- LNG Import Terminal-Proposed (only)
  →development of related LNG infrastructure
- 25~35% in power generation mix
  →competition with coal and renewable

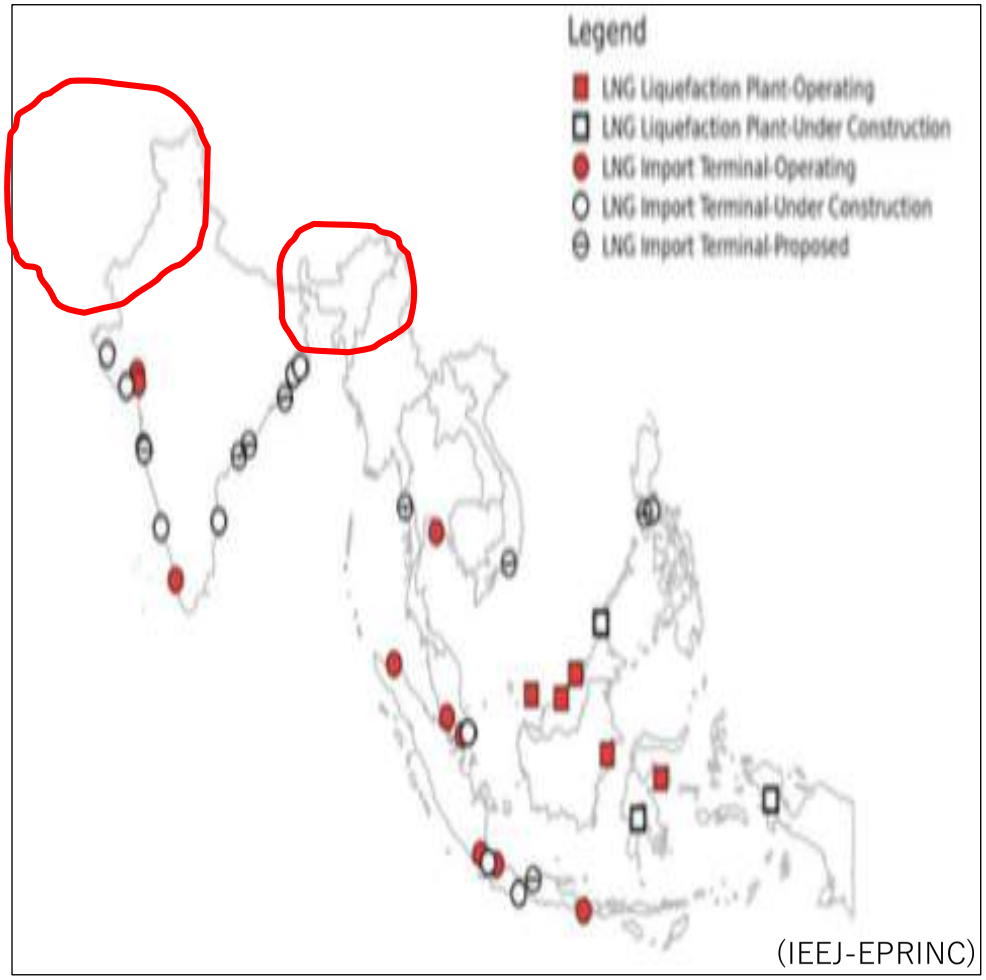




LNG market potential in South East / South Asia ②

- **Pakistan**
- **Bangladesh**

- FSRU (operating/construction), long-term contract
- Started to import LNG + Domestic gas production
- **High country risk**
  →financial support by ECAs and MDBs



Country Risk Assessment of Selected Asian Countries

	Large = High risk Small = Low risk
Singapore	0
China	2
Malaysia	2
India	3
Indonesia	3
Philippines	3
Thailand	3
Bangladesh	5
Vietnam	5
Cambodia	6
Myanmar	6
Sri Lanka	6
Pakistan	7

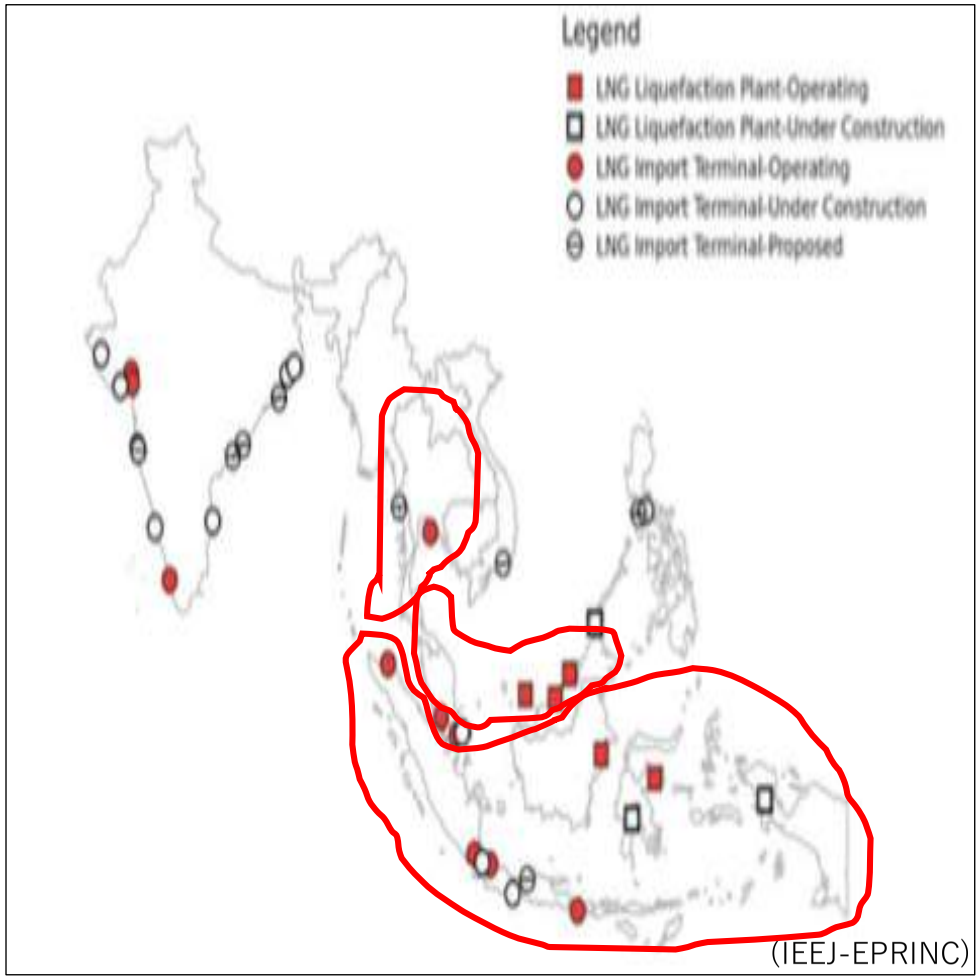
Source: Organization of Economic Cooperation and Development (2017)

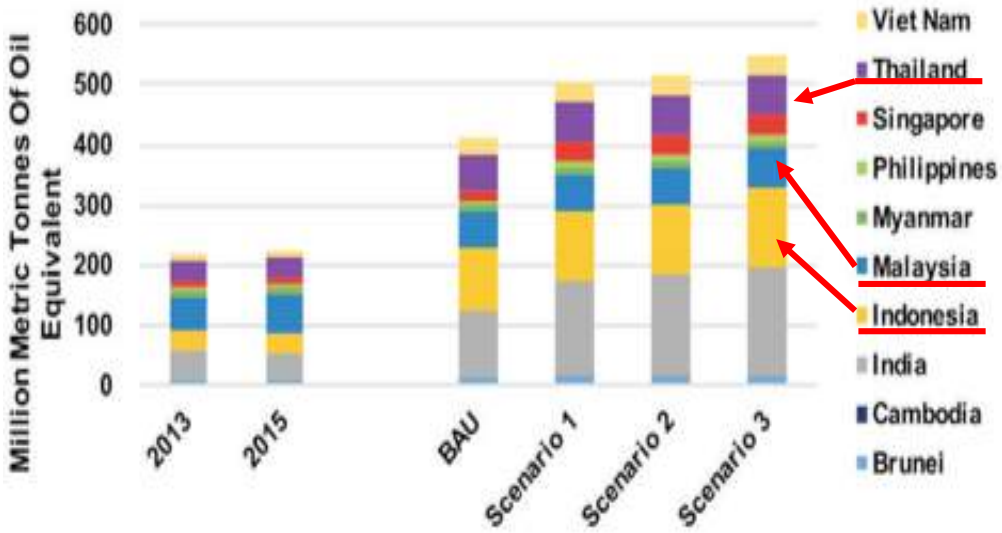
IEEJ-EPRINC

LNG market potential in South East / South Asia ③

- **Malaysia**
- **Indonesia**
- **Thailand**

- LNG Import Terminal(Operating)
- Stable business environment
- Expected large LNG market in the near future
  →create more business opportunities





Policy recommendations from IEEJ/EPRINC

- The policy recommendations from IEEJ/EPRINC were **reported** to both **US and Japanese governments** and discussed at the 6th LNG Producer Consumer Conference on Oct 18th, 2017 in Tokyo.

1. Developing more liquid and flexible LNG market

- Removal of LNG destination restrictions in LNG contracts to stimulate spot markets and price discovery
- Hold close dialogue between producers and consumers to share market outlook and to promote competition and LNG growth

2. Preparing for expansion of US LNG production and export

- Enhancing competitiveness of US LNG export
- Streamlining of regulatory process, including LNG export approval process
- Improving accessibility of the Panama Canal

3. Supporting the expansion of the Asian LNG market

- Developing and reforming policies and regulations in Asia
- Financial Support for infrastructure development by export credit agencies
- Providing capacity building

Announcement at LNG Producer Consumer Conference

- The 6th Conference was held on October 18th, 2017 with attendance of 12 ministers from consuming and producing countries.
- Minister Seko announced Japan's contribution and commitment (**$10 billion** financing and **500 people** capacity building) to expand Asian LNG market.

JAPAN'S CONTRIBUTION/COMMITMENT

Finance

$10 billion of investment by Japan's public and private sectors

Capacity Building

500 people

In 5 years

JAPAN'S PROMISE

Liquid LNG Markets

New LNG Utilization Measures

International Consensus on the benefits of LNG

US-Japan Energy/Infrastructure Cooperation

- **US and Japan agreed to promote cooperation on the following at the US-Japan Summit（Nov 6, 2017）**

  ①To promote **Japan-US Strategic Energy Partnership (JUSEP)** under the Japan-US Economic Dialogue

  ②To collaborate on Infrastructure cooperation in third countries through financial cooperation between government agencies

  (i) MOC b/w METI and USTDA, (2) MOU b/w NEXI/JBIC and OPIC

Japan-US Strategic Energy Partnership (JUSEP)

<2 principles>

(1) Open and competitive energy market are indispensable to ensuring secure energy supply

(2) Universal access to affordable and reliable energy is needed to help eradicate poverty, fuel economic growth, and increase global security

<4 Priorities>

(1)Advanced nuclear technology

(2)HELE coal technology, including CCUS

(3)Global market for natural gas

(4)Energy infrastructure

<3 Geographic regions>

(1) Southeast Asia

(2) South Asia

(3) Sub-Saharan Africa

JBIC -Japan Bank for International Cooperation-

Profile ~Japan's official ECA (export credit agency)~

Name: Japan Bank for International Cooperation（JBIC）
Capital: US$15.5 billion*
Outstanding (Loans and Equity): US$135 billion*
Disbursement amount : US$22 billion*　　* FY2016

The Mission of JBIC

JBIC's mission is to contribute to the sound development of Japan and international economy and society by providing financing services targeting four main objectives:

- Promoting **the overseas development and securement of resources** which are **important for Japan**
- Maintaining and improving **the international competitiveness** of **Japanese industries**
- Promoting the overseas business having the purpose of **preserving the global environment**, such as preventing global warming
- Preventing disruptions to international financial order or taking appropriate measures with respect to damages caused by such disruption (**Market Stability**)

NEXI - Nippon Export and Investment Insurance -

Profile ~Japan's official ECA (export credit agency)~

Name: Nippon Export and Investment Insurance ("NEXI")
Capital: US$1.5 billion
Outstanding commitment: US$ 145 billion*
Underwritten Amount: US$ 65 billion* *FY2016

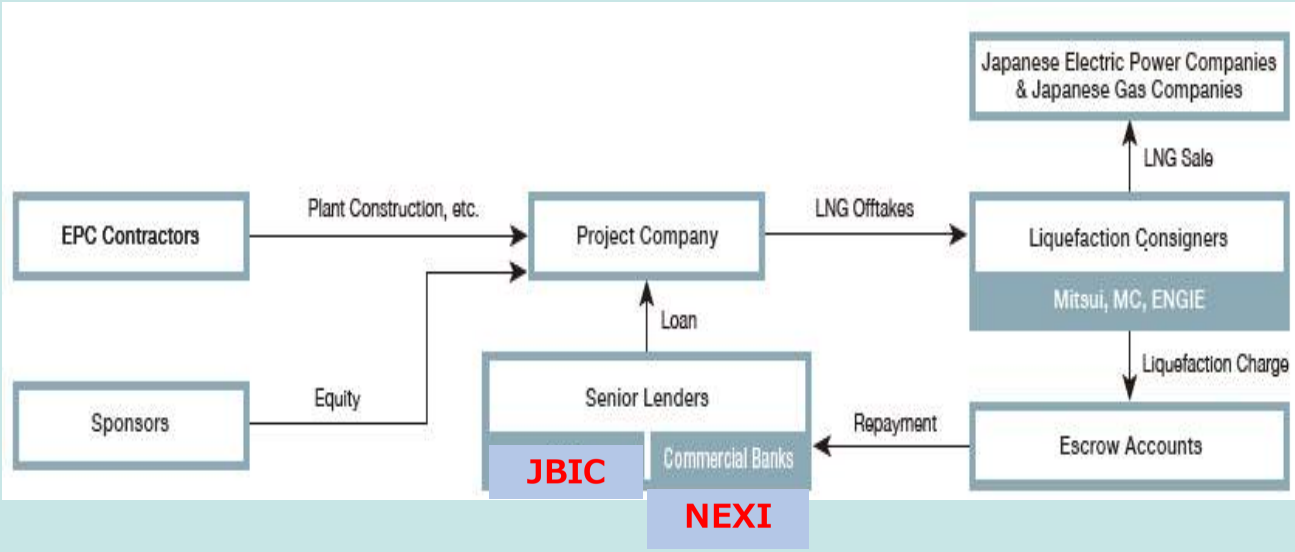
Scope of Business (abstract)

1)To conduct **trade and investment insurance business operations** complying with the provision of Chapter III of the Trade and Investment Insurance Act of Japan.
2)To conduct business incidental to the business stated in 1) above.

Purpose

To efficiently and effectively conduct insurance business of covering risks which arise in foreign transactions and which are not covered by commercial insurance

Cameron LNG Project



Project Description: Construct a new liquefaction plant in an existing LNG receiving base and produce 12 million tons of LNG per annum.

Project Company: Cameron LNG, LLC incorporated in the United Sates

Location: Louisiana, the United Sates

Loan Signing: August 6, 2014

Sponsors: Sempra Energy, ENGIE, **Mitsui & Co., Ltd., Mitsubishi Corporation and Nippon Yusen Kabushiki Kaisha**

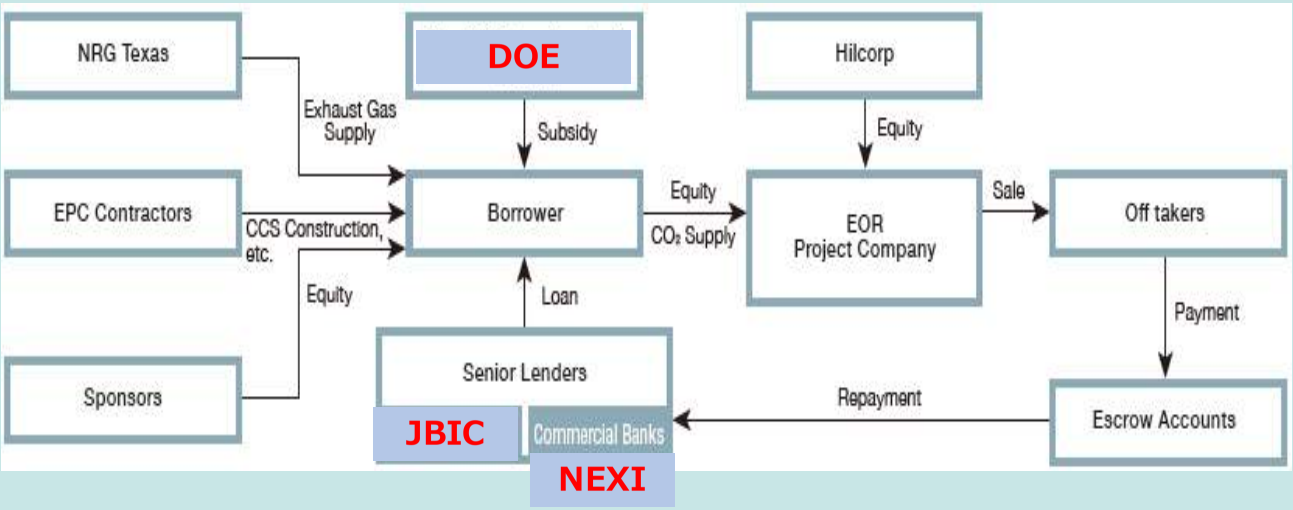
Other US/Japanese Companies: **Chiyoda Corporation**

Total Co-financing Amount: **USD 7,415 million**

JBIC Loan Amount: **USD 2,500 million**

NEXI Insurance Amount: **USD2,000 million**

CO2-EOR Project



Project Description: Increase crude oil recovery through Enhanced Oil Recovery (EOR) technology, which injects into an oil well extracted and collected from the exhaust gas of a coal-fired power plant, utilizing a CO2 recovery plant (CCS).

Project Company: Texas Coastal Ventures, LLC

Location: Texas, the United States

Loan Signing: July 14, 2014

Sponsors: NRG Energy, Inc.
JX Nippon Oil & Gas Exploration Corporation

Other US/Japanese Companies:
Hilcorp Energy Company
Mitsubishi Heavy Industries Ltd

Total Co-financing Amount:
USD 250 million

JBIC Loan Amount:
USD 175 million

NEXI Insurance Amount:
USD 75million

Way Forward: Our Plan in 2018

US-Japan Joint Research / Workshops

Three workshops on US-Japan LNG cooperation in Asia in 2018

① **July** **in Jakarta, Indonesia**
② **August** **in Tokyo, Japan**
③ **September** **in Washington DC, US**

ERIA (Economic Research Institute for ASEAN and East Asia) Projects

- **Research** on LNG receiving or utilizing projects in ASEAN
- **Gas master plan** development for Myanmar.

LNG Producer and Consumer Conference

- **October 22nd, 2018 (@Nagoya, Japan)**

Thank you!

Takeshi SODA

(email) soda-takeshi@meti.go.jp

Annual Benefits of US LNG Exports*

GDP

$47.22 Billion (low)
$53.11 Billion (medium)
$92.72 Billion (high)

JOBS

205,400 (low)
270,100 (medium)
432,900 (high)

*Average annual direct, indirect, and induced impacts from 2013-2050, calculated by ICF for LNG Allies, based on Feb. 2018 EIA scenarios.

www.lngallies.com/jobs.pdf

Cumulative Benefits of US LNG Exports*

GDP

$1.66 Trillion (low)
$1.89 Trillion (medium)
$3.26 Trillion (high)

Job-Years

7.35 Million (low)
9.68 Million (medium)
15.46 Million (high)

*Cumulative direct, indirect, and induced impacts from 2013-2050, calculated by ICF for LNG Allies, based on Feb. 2018 EIA scenarios.

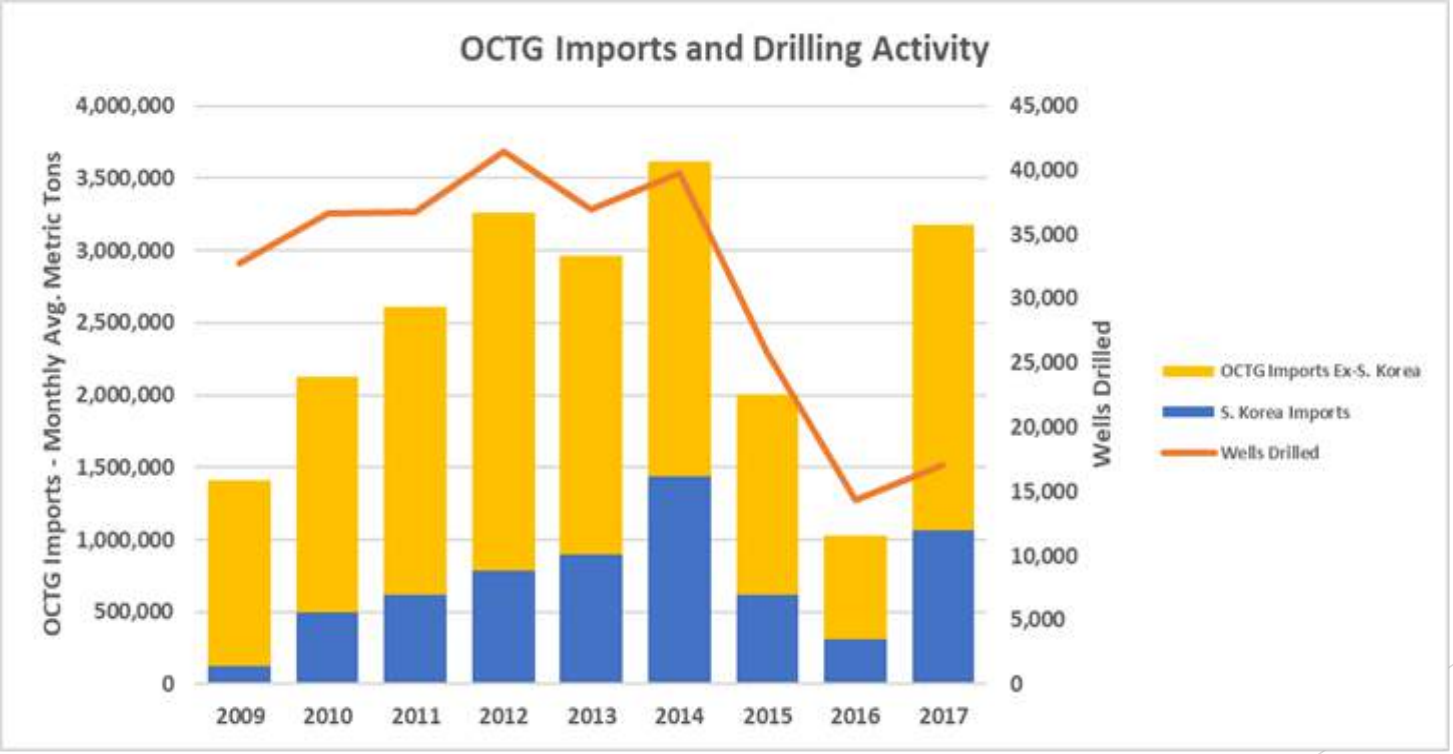
www.lngallies.com/jobs.pdf

IPAA

Frederick J. Lawrence

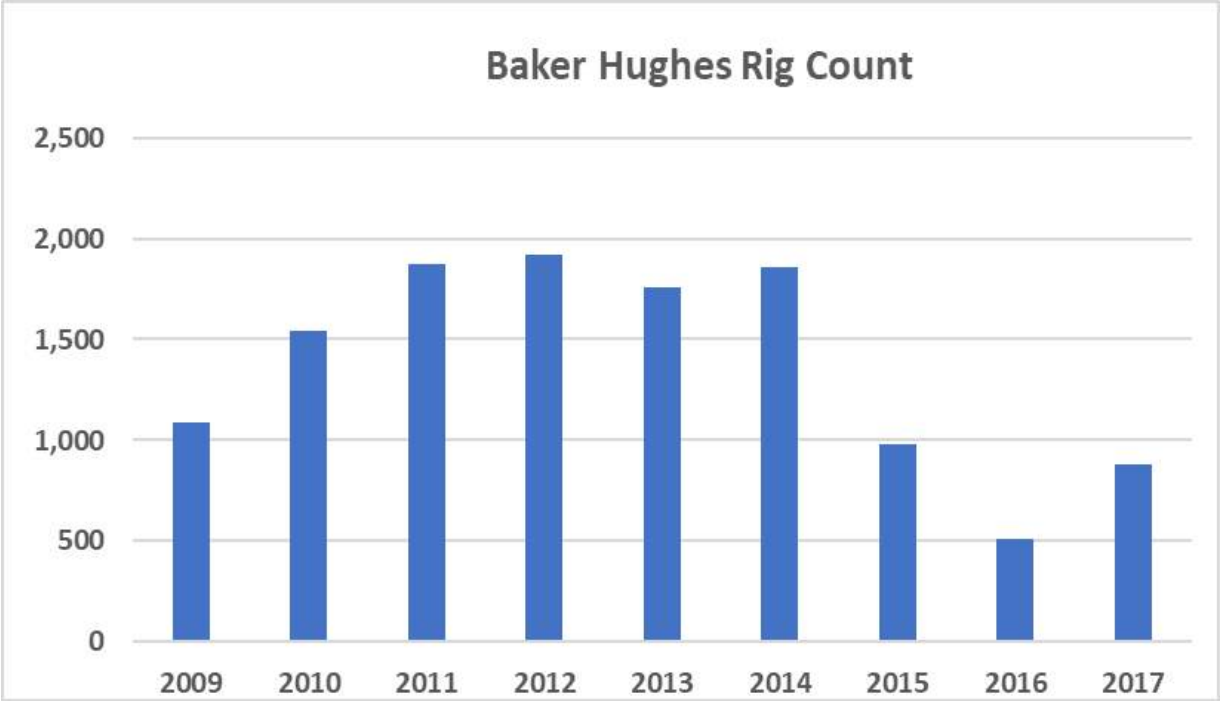
VP-Economics & International Affairs

Oil Country Tubular Goods



Source: Census and IHS Markit

Rig Count – More with Less



Source: Baker Hughes

Top Importers – 2017 OCTG and LP

S. Korea	697,086	1,062,178	1,759,264
Mexico	160,131	454,659	614,790
India	392,950	8,900	401,850
Canada	175,442	183,929	359,371
Germany	148,856	58,617	207,473
Brazil	47,340	158,285	205,625
Argentina	6,541	192,932	199,473
Taiwan	60,113	132,472	192,585
Austria	0	163,569	163,569
Russia	30,839	127,508	158,347
Japan	54,104	89,930	144,034