

Advent of Shale Gas – Impact on Global Downstream Polyethylene

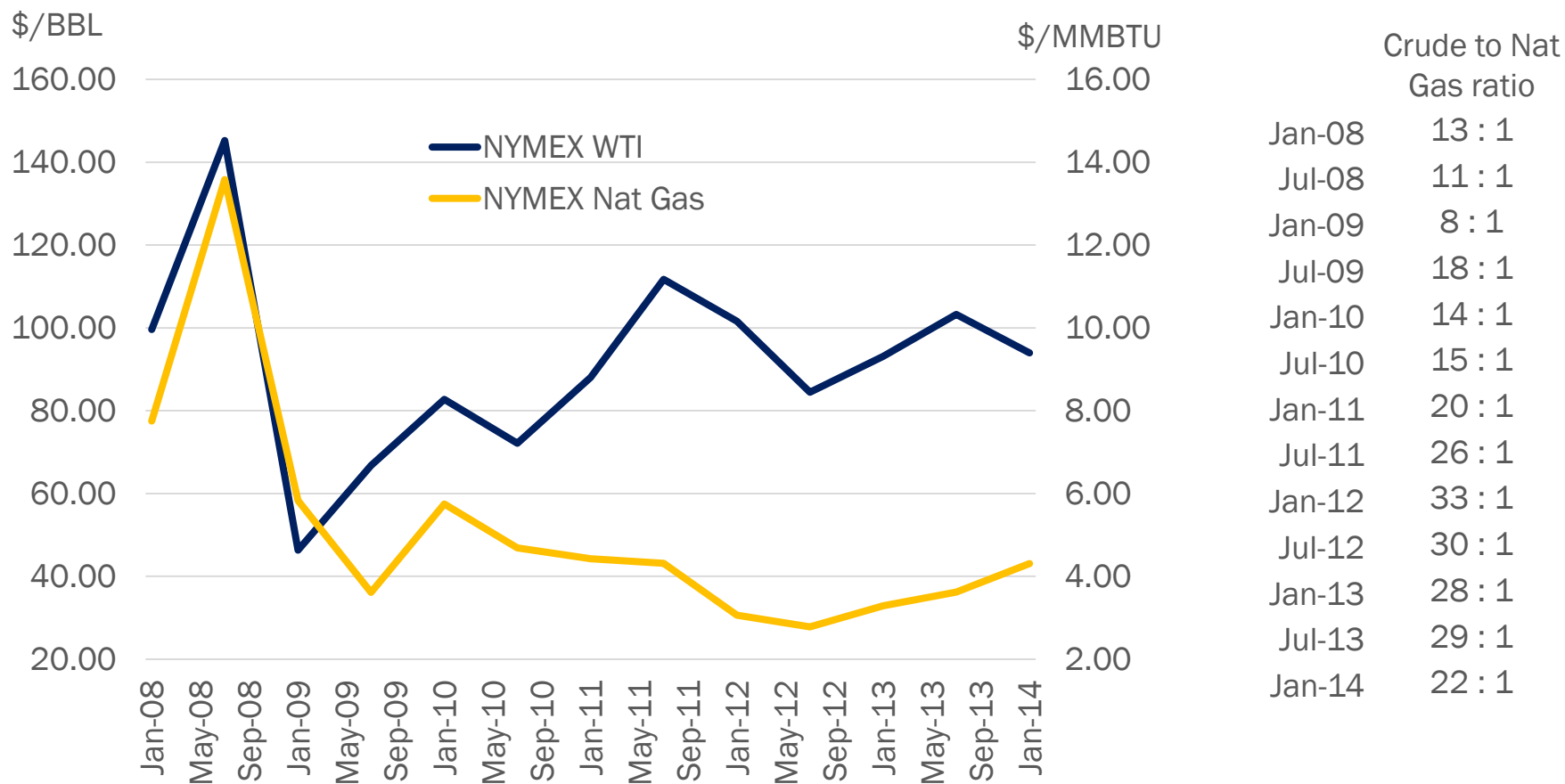
IOC's 3rd Petrochemical Conclave
February 2014

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Agenda:

- **US shale gas impact on...**
 - WTI & Natural Gas prices
 - US ethane price
- **What fundamental changes can we expect to see in...**
 - US ethylene
 - US polyethylene
- **Is the market facing a polyethylene surplus...**
 - ...or not?

US shale impact on WTI & natural gas



Source:
Petrochemwire

Shale gas impact on US ethane price

	NYMEX WTI (\$/bbl)	NYMEX Nat Gas (\$/mmbtu)	Ethane (\$/gal)	Ethane (\$/mt)	Ethane to Crude ratio	Ethane to Nat Gas ratio
Jan-08	\$99.62	\$7.75	\$1.15	\$856	86 : 1	7 : 1
Jul-08	\$145.25	\$13.58	\$1.43	\$1,063	101 : 1	9 : 1
Jan-09	\$46.34	\$5.83	\$0.40	\$297	116 : 1	15 : 1
Jul-09	\$66.73	\$3.62	\$0.48	\$354	140 : 1	8 : 1
Jan-10	\$82.75	\$5.75	\$0.81	\$597	103 : 1	7 : 1
Jul-10	\$72.14	\$4.69	\$0.46	\$338	159 : 1	10 : 1
Jan-11	\$88.03	\$4.42	\$0.61	\$451	145 : 1	7 : 1
Jul-11	\$111.72	\$4.31	\$0.78	\$579	143 : 1	6 : 1
Jan-12	\$101.56	\$3.06	\$0.76	\$562	134 : 1	4 : 1
Jul-12	\$84.45	\$2.78	\$0.29	\$215	291 : 1	10 : 1
Jan-13	\$93.09	\$3.29	\$0.23	\$170	407 : 1	14 : 1
Jul-13	\$103.22	\$3.62	\$0.24	\$179	428 : 1	15 : 1
Jan-14	\$93.96	\$4.30	\$0.28	\$208	336 : 1	15 : 1

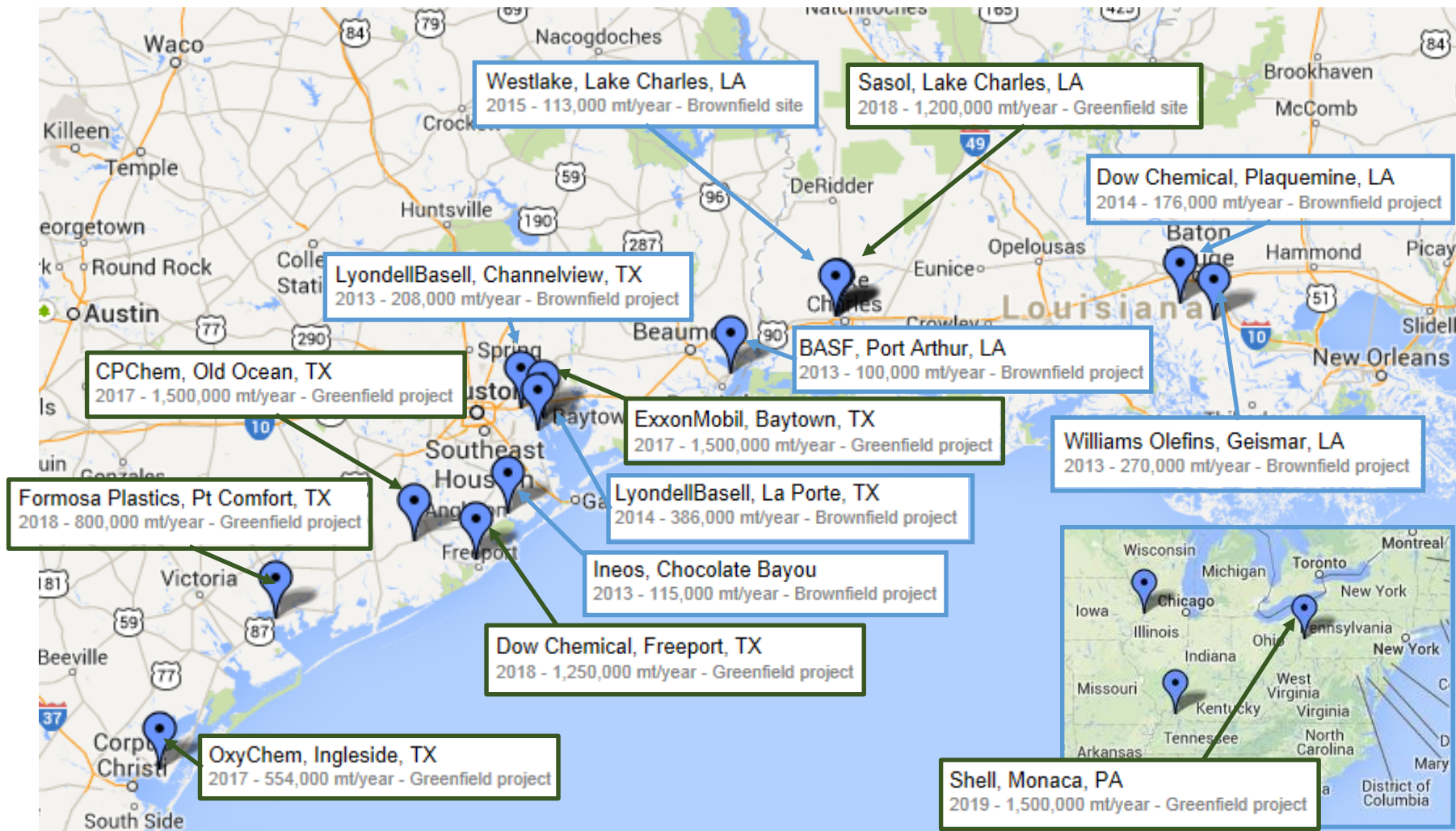
Source:
Petrochemwire

Shale gas impact on US ethylene price

	Ethane (\$/gal)	Ethane (\$/mt)	Ethane to ethylene ratio	Ethylene (cents/lb)	Ethylene (\$/mt)
Jan-08	\$1.15	\$856	2.2 : 1	52.000	1146.08
Jul-08	\$1.43	\$1,063	2.0 : 1	71.000	1564.84
Jan-09	\$0.40	\$297	2.0 : 1	20.250	446.31
Jul-09	\$0.48	\$354	2.2 : 1	22.000	484.88
Jan-10	\$0.81	\$597	2.1 : 1	39.000	859.56
Jul-10	\$0.46	\$338	1.3 : 1	34.500	760.38
Jan-11	\$0.61	\$451	1.4 : 1	44.000	969.76
Jul-11	\$0.78	\$579	1.4 : 1	55.500	1223.22
Jan-12	\$0.76	\$562	1.3 : 1	56.750	1250.77
Jul-12	\$0.29	\$215	0.7 : 1	42.375	933.95
Jan-13	\$0.23	\$170	0.4 : 1	59.500	1311.38
Jul-13	\$0.24	\$179	0.4 : 1	57.000	1256.28
Jan-14	\$0.28	\$208	0.5 : 1	58.375	1286.59

Source:
Petrochemwire

US ethylene plant projects to add over 12 million mt capacity



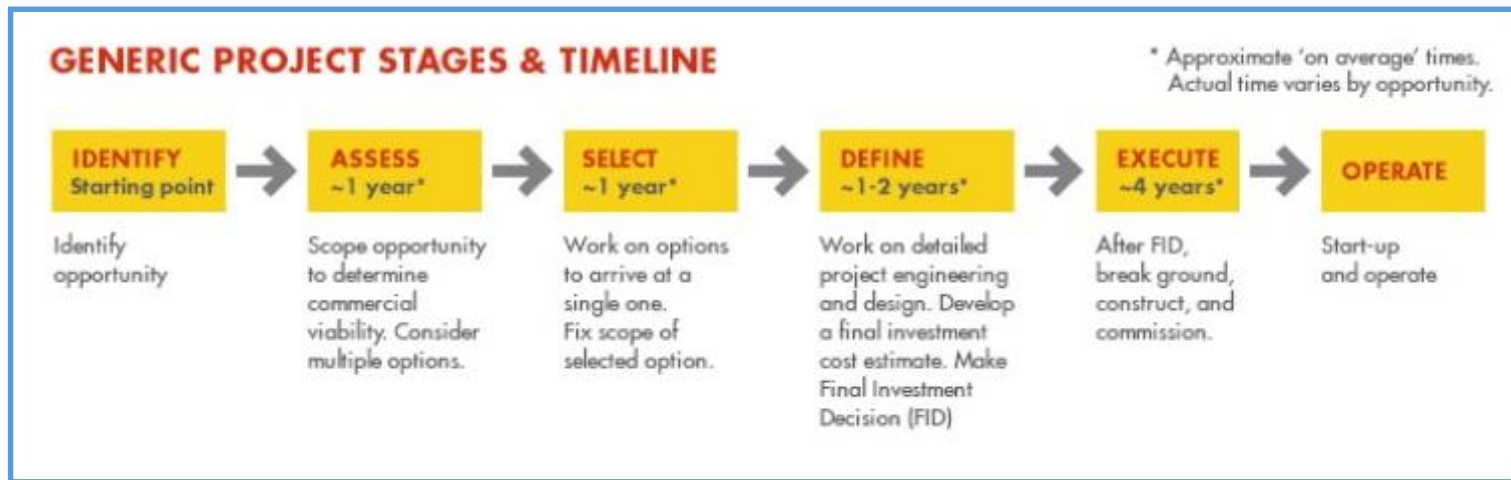
Source: TPS/Petrochemwire

What fundamental changes can we expect in ethylene?

- Shale-based natural gas (and NGLs) have created record margins for the past 3 years for US ethylene producers.
- US ethylene capacity at 26 million mt/year in 2013.
- By 2018-2020 period, we could expect another 11-12 million mt of new ethylene capacity.
- ...that is if all greenfield and brownfield projects are realized, bringing a total of 37-38 million mt.

What fundamental changes can we expect in ethylene?

- However, not all projects will be built on time, or will be built at all.
- We should expect an addition of 7-8 million mt of new ethylene capacity by 2018-2020.



Source: Shell

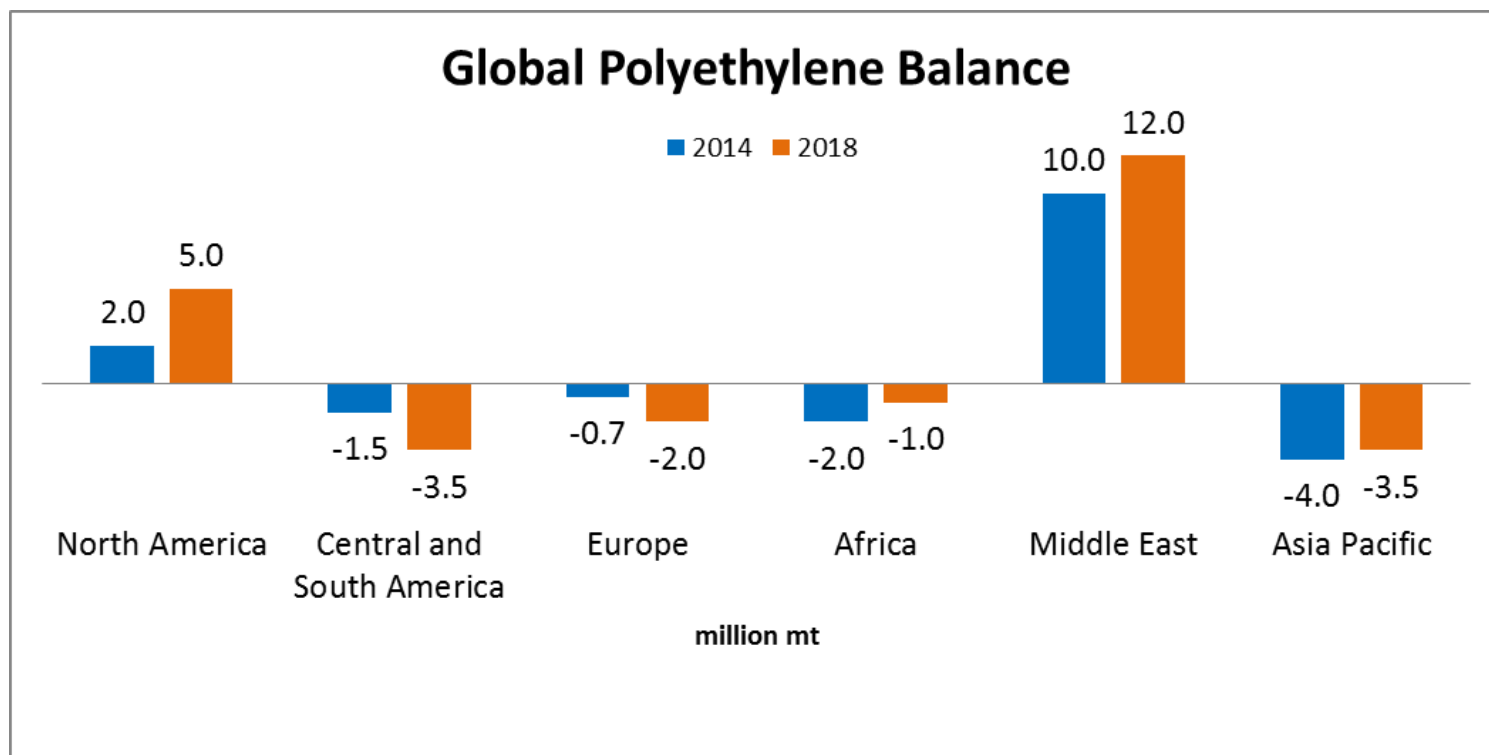
What fundamental changes can we expect in polyethylene?

- With new ethylene plants being built, so will new PE production.
- US alone could add about 6 million mt of new PE capacity by 2018-2020, but doubt remains of full capacity addition.
- Canada and Mexico to add 1.4 million mt.

Who	Where		How much ('000 mt)	When
Braskem/ Group Idesa	Coatzacoalcos	Mexico	1,050	2015
Nova	Joffre	Canada	454	2015
Sasol/ Ineos	Lake Charles	US	470	2016
LyondellBasell	Corpus Christi	US	454	2016
Sasol	Lake Charles	US	420	2016
Appalachian Resins	W Virginia	US	227	2016
CP Chem	Old Ocean	US	1,000	2017
ExxonMobil	Baytown	US	1,300	2017
Sasol	Lake Charles	US	450	2018
Formosa	Point Comfort	US	300	2018
Shell	Appalachia	US	Under study	NA
Odebrecht/ Braskem	W Virginia	US	Under study	NA

Will the world be able to absorb the PE “surplus”?

- Global polyethylene market to remain in marginal surplus.
- Don't expect any PE tsunami from the US as Middle East will still be the dominant supplier into Europe, Africa and Asia.



Source: PCW, TPS, Industry

Conclusion

- US advantage is clear – the question is whether US can capitalize fully.
- New ethylene and PE production in the US so far has only been seen in expansions, but new plants have not come online yet.
- Middle East to remain as the dominant supplier of surplus PE; Asia the main consumer.
- Some questions:
 - What can be done to capture benefits while the PE market waits for its turn?
 - Can China's Methanol-To-Olefins alternatives put the brakes on shale developments?

About The Petrochemical Standard (TPS)

- The Petrochemical Standard was set up to address a growing need within the global petrochemical market for reliable real-time pricing information that can be delivered digitally on all major mobile platforms in a form that provides just the right insights when they are needed most.
- TPS is fortunate to be supported by one of the largest and most reputable media and information services businesses in the world. They are assisting us in developing better and more timely information delivery systems to aid our customers in making critical pricing decisions at the most opportune times.
- Currently, TPS publishes daily Asian aromatics price assessments for benzene, toluene, paraxylene, mixed xylene, styrene monomer and methanol.

Thank You

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