

Coal & Natural Gas Chemicals

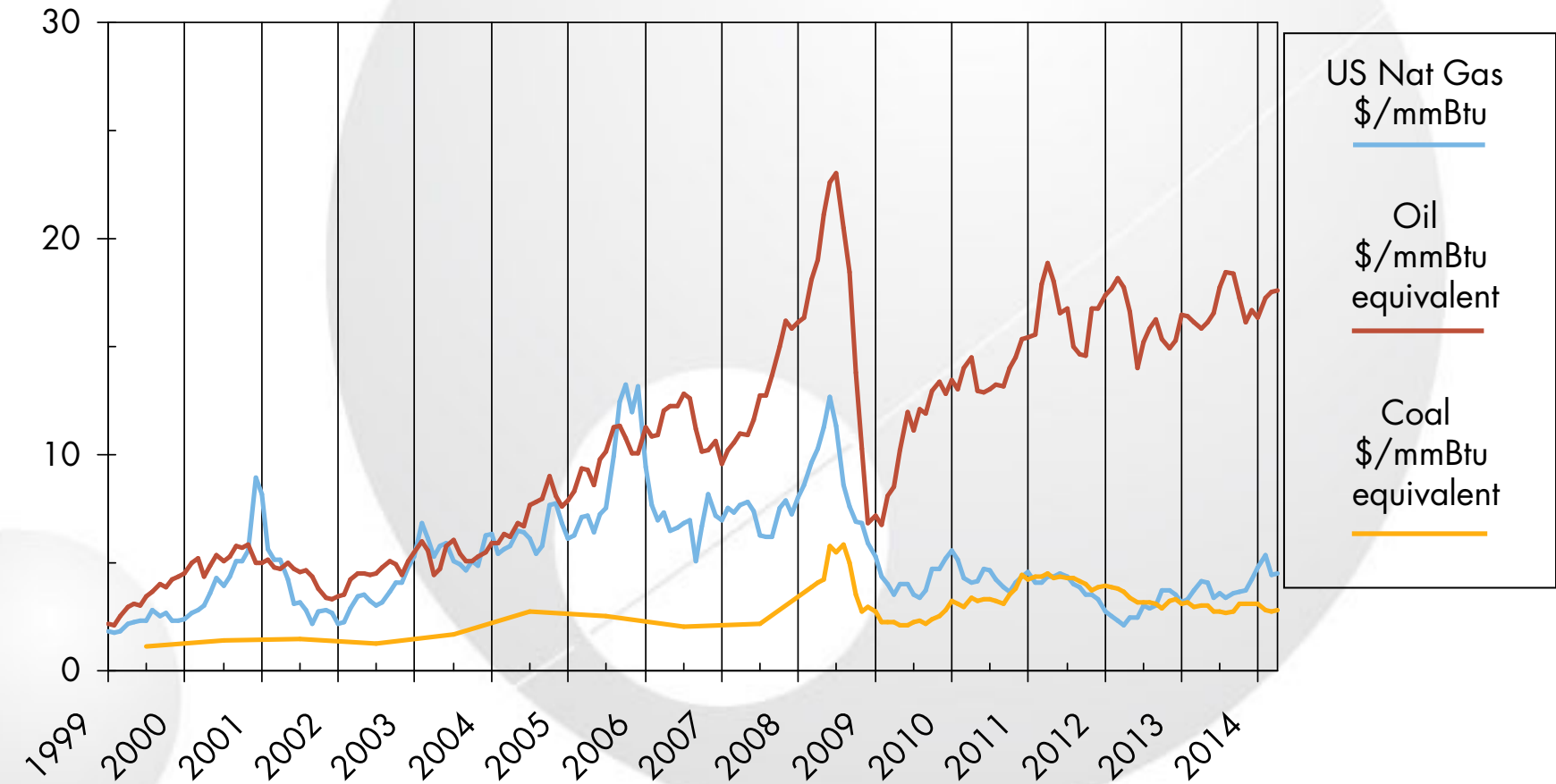
Tecnon OrbiChem Marketing Seminar at APIC 2014
Pattaya, 15 May 2014

Gillian Tweddle

APIC 2014

NATURAL GAS, CRUDE OIL & COAL PRICES

\$/mmBtu

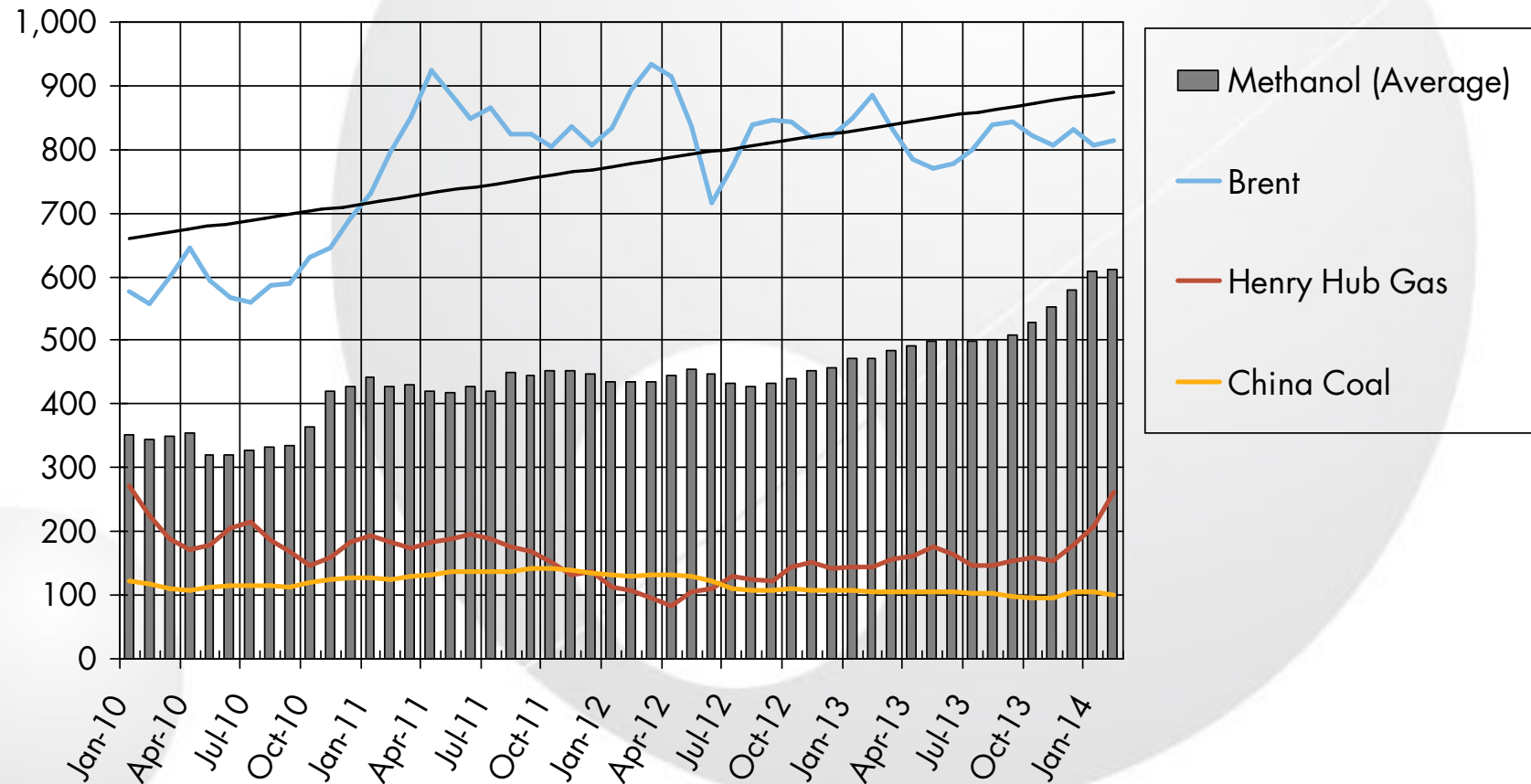


Source: Tecnon OrbiChem

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METHANOL CONTRACT vs BRENT, HENRY HUB GAS & COAL PRICES

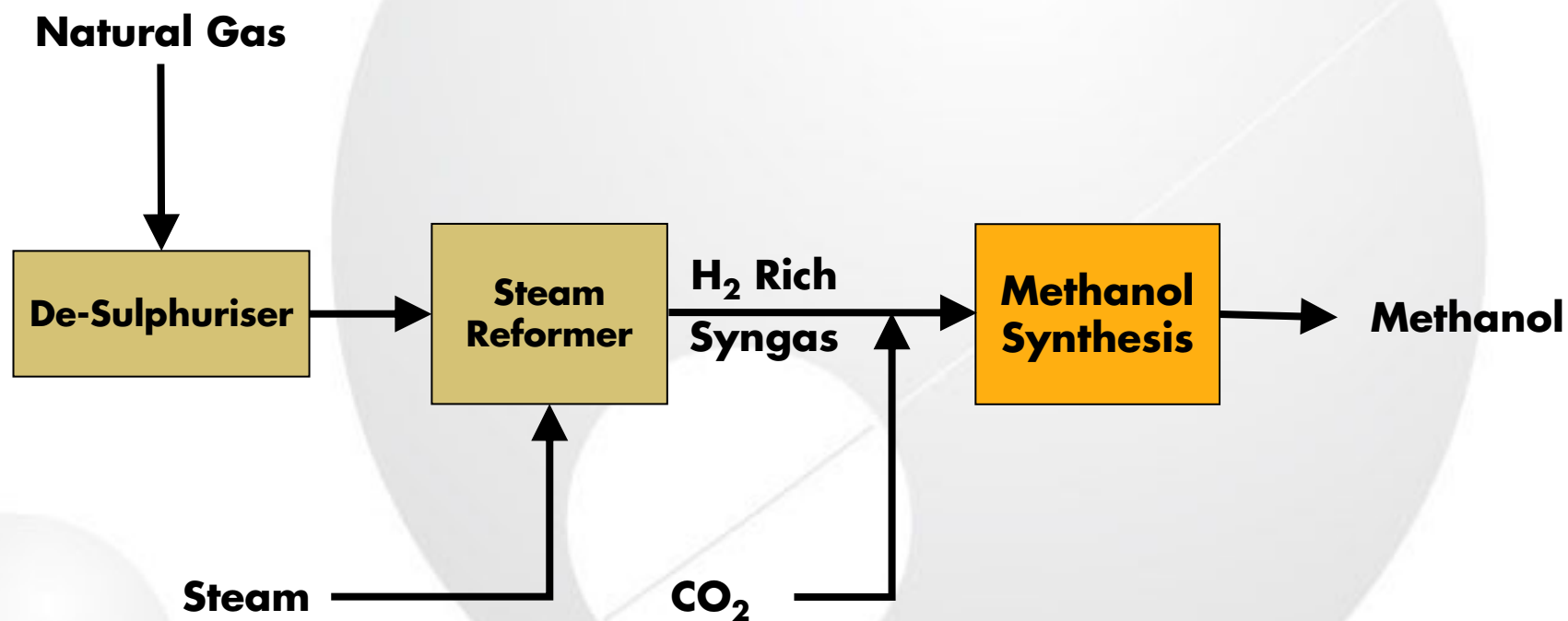
Dollars per Ton



Source: Tecnon OrbiChem

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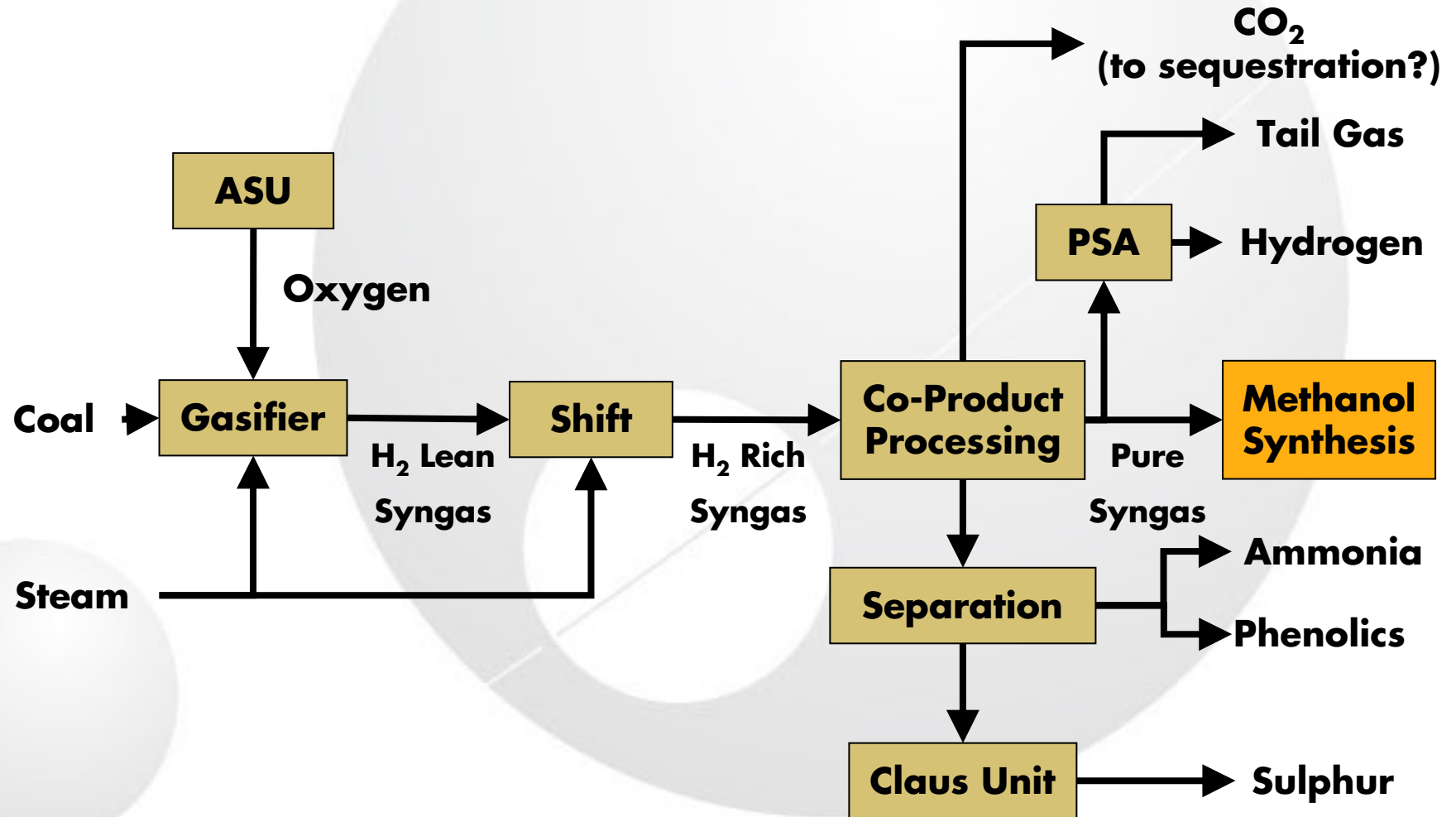
NATURAL GAS-BASED SYNTHESIS GAS AND METHANOL PRODUCTION



Source: Tecnon OrbiChem

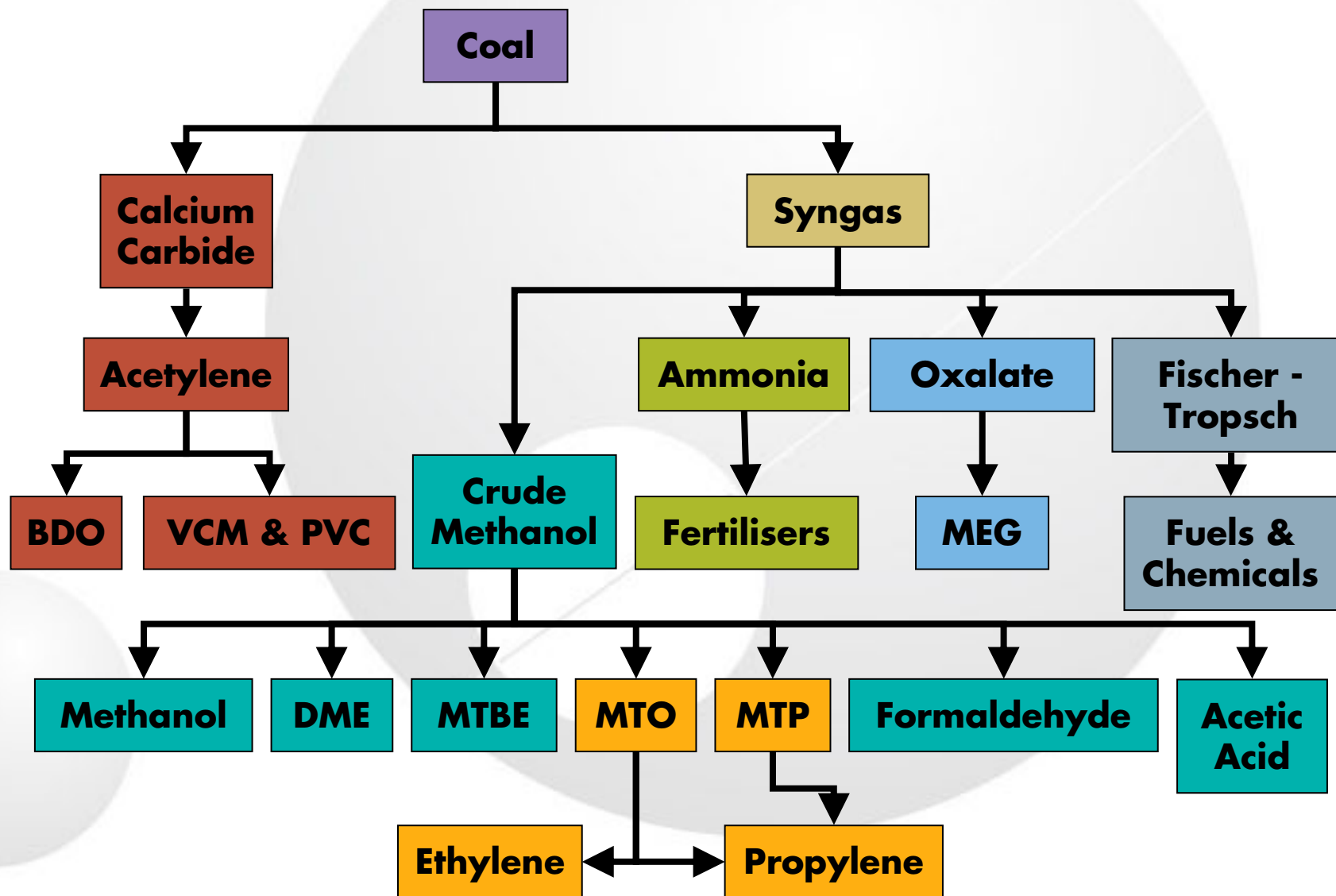
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COAL-BASED SYNTHESIS GAS TO METHANOL PRODUCTION



Source: Tecnon OrbiChem

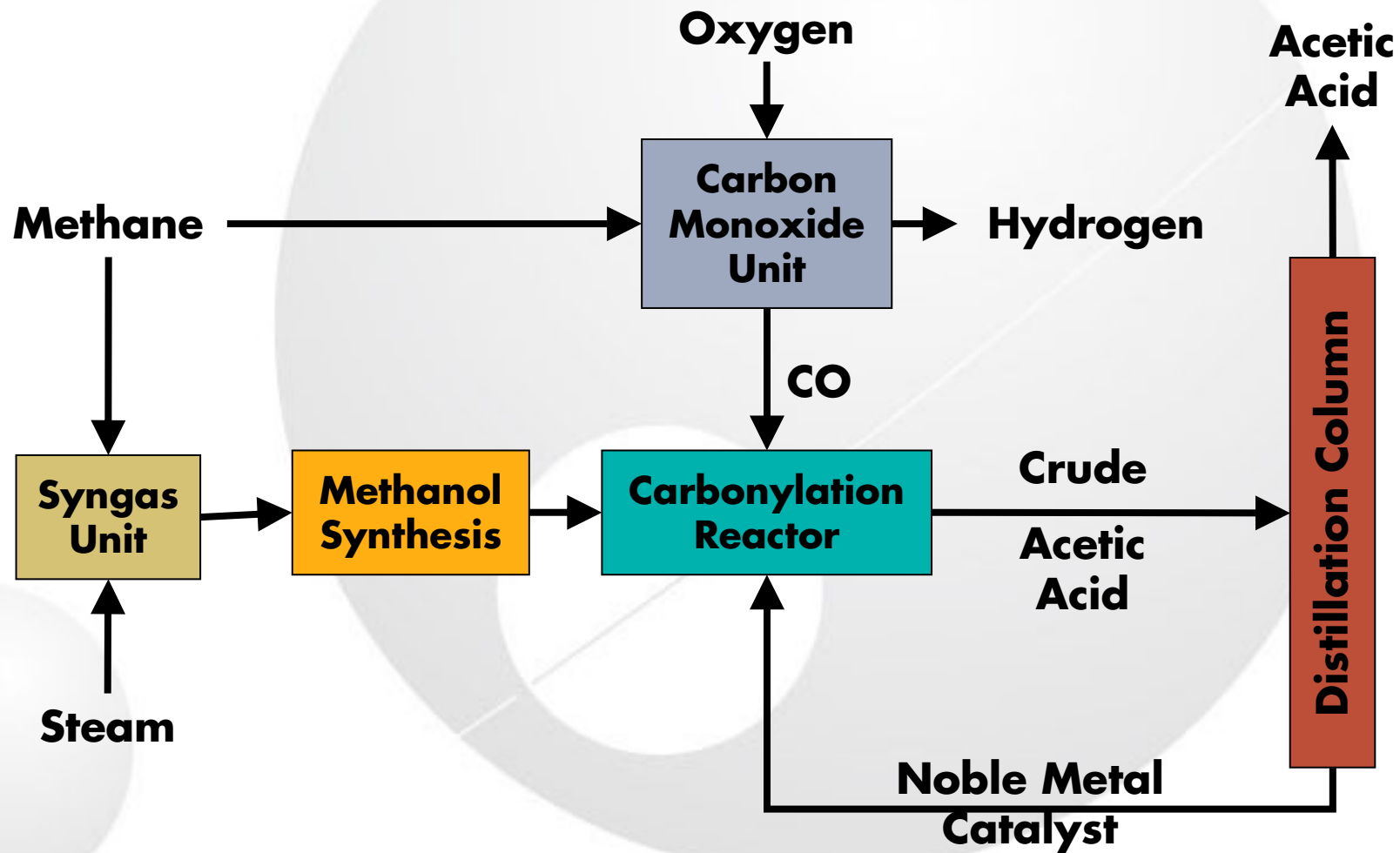
APIC 2014 CHEMICALS FROM COAL



Source: Tecnon OrbiChem

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METHANE TO METHANOL TO ACETIC ACID

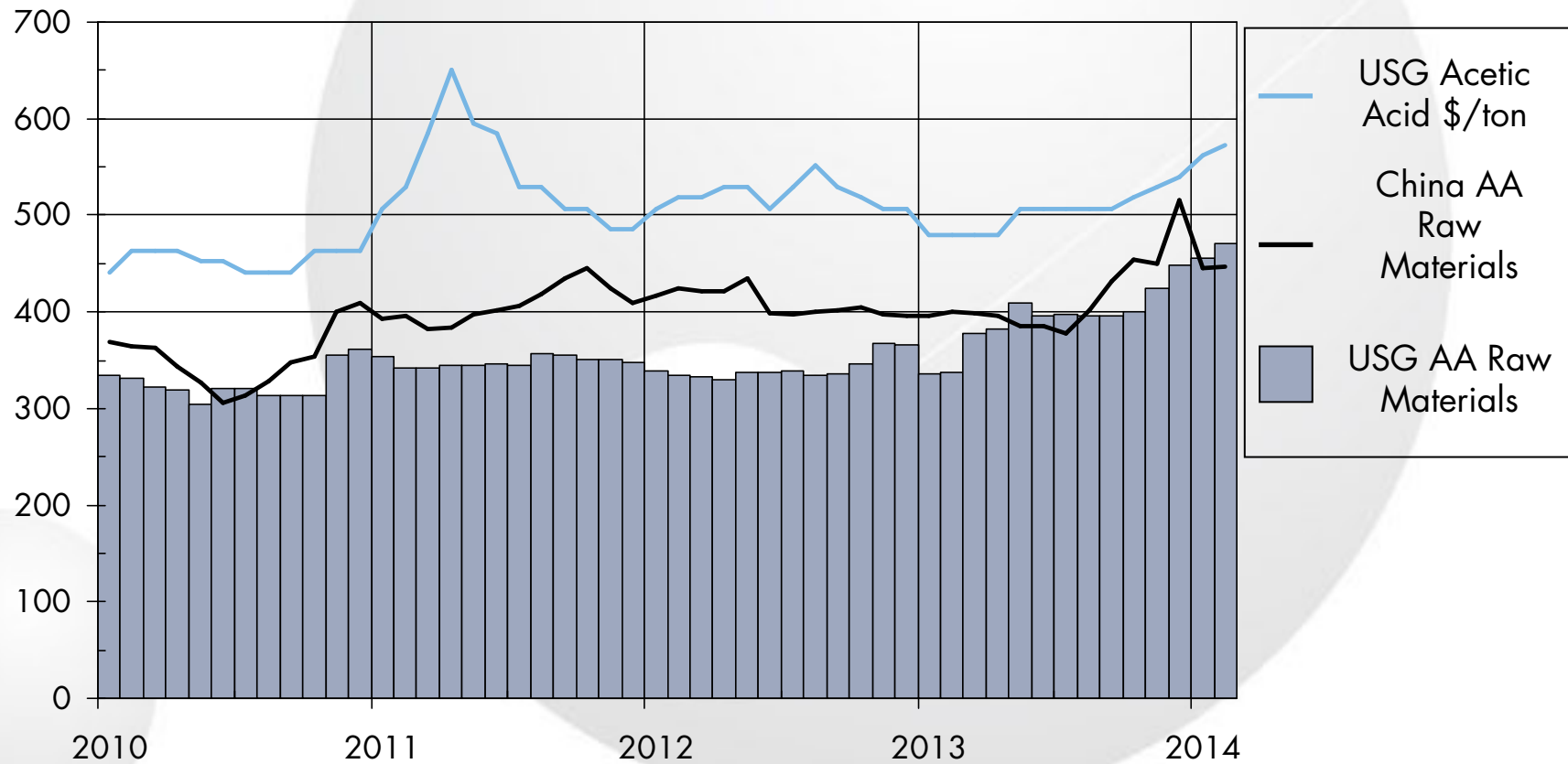


Source: Tecnon OrbiChem

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ACETIC ACID PRODUCTION COSTS - US vs CHINA

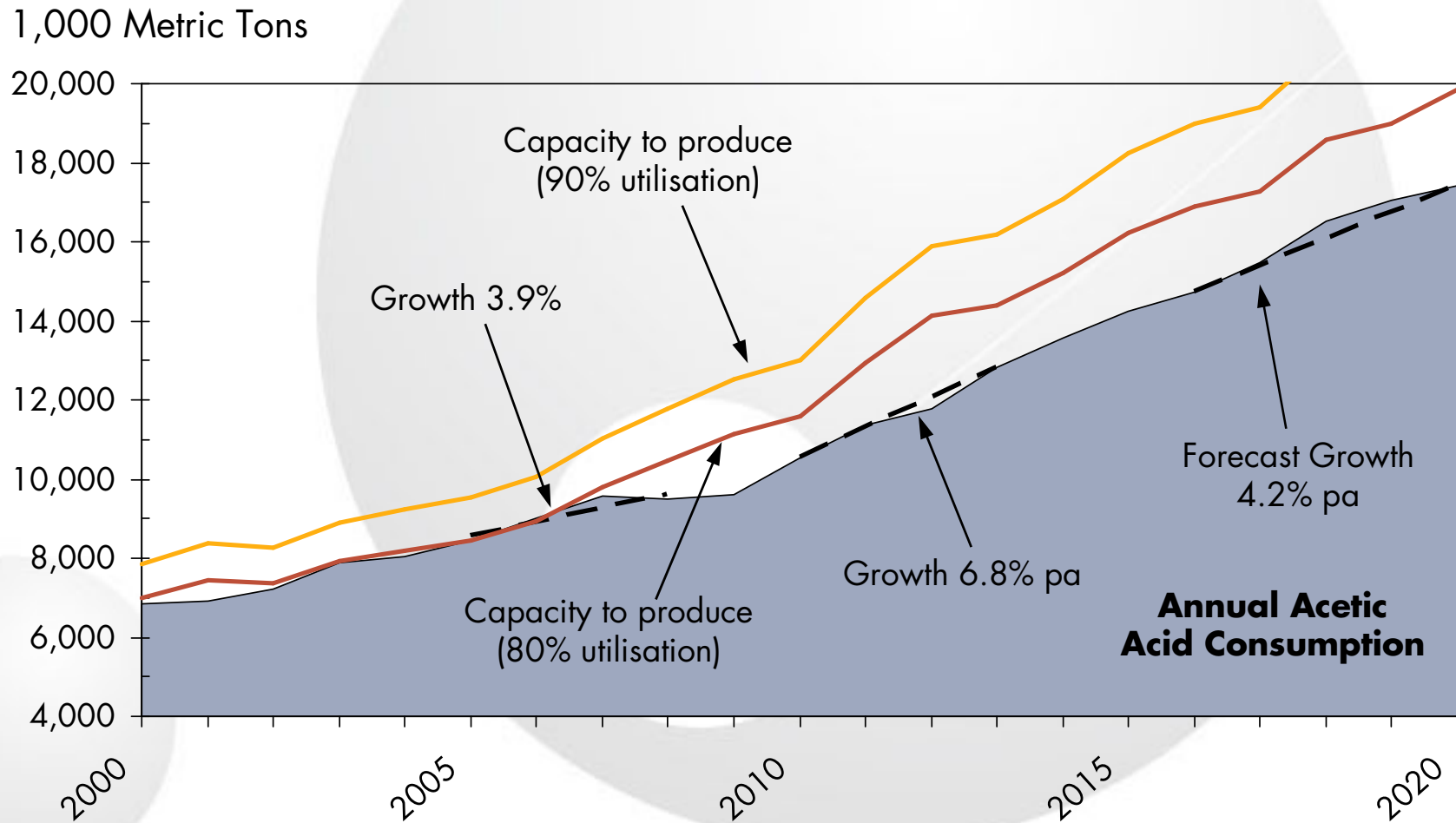
Dollars per Ton



Source: Tecnon OrbiChem

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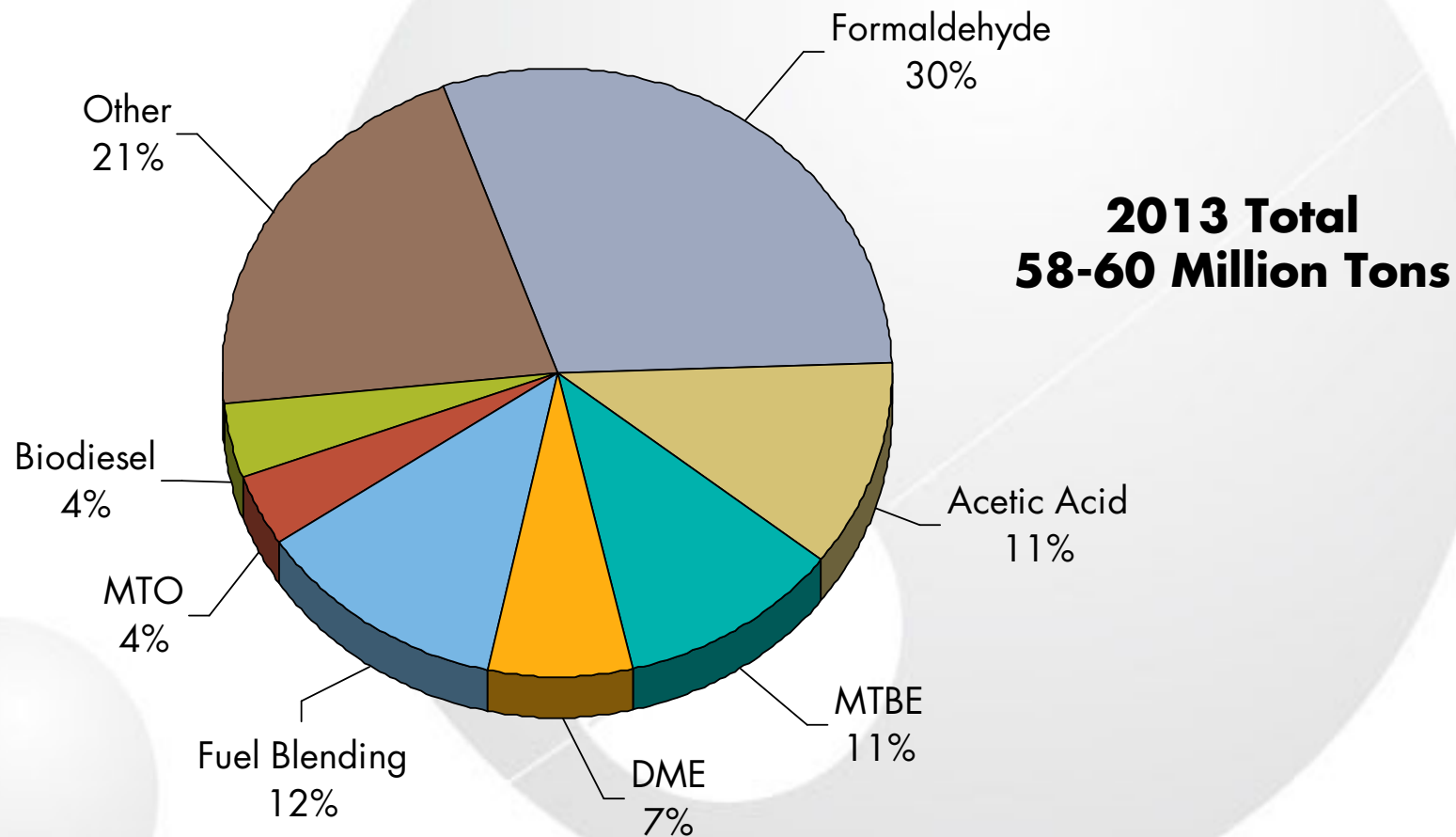
WORLD ACETIC ACID CAPACITY vs DEMAND



Source: Tecnon OrbiChem

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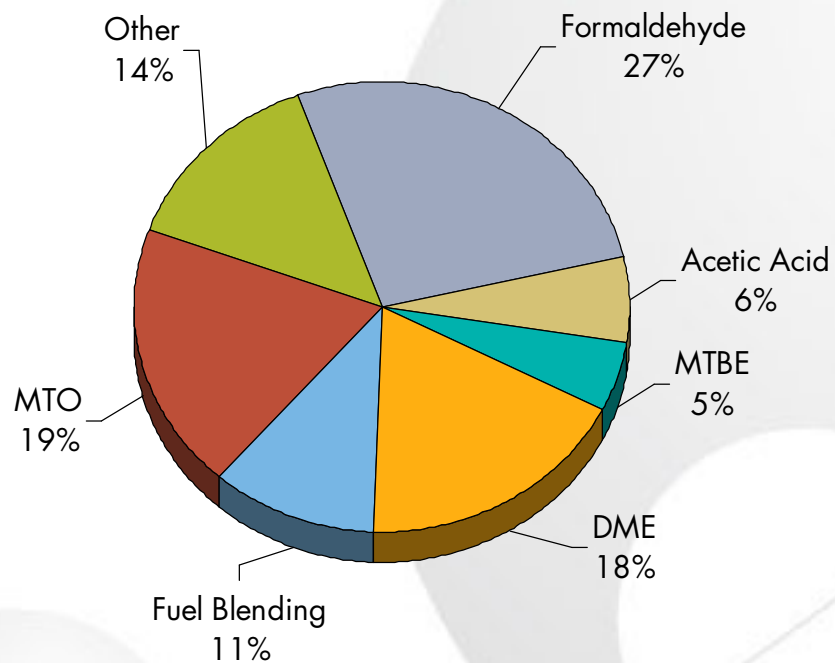
GLOBAL METHANOL DEMAND BY END-USE



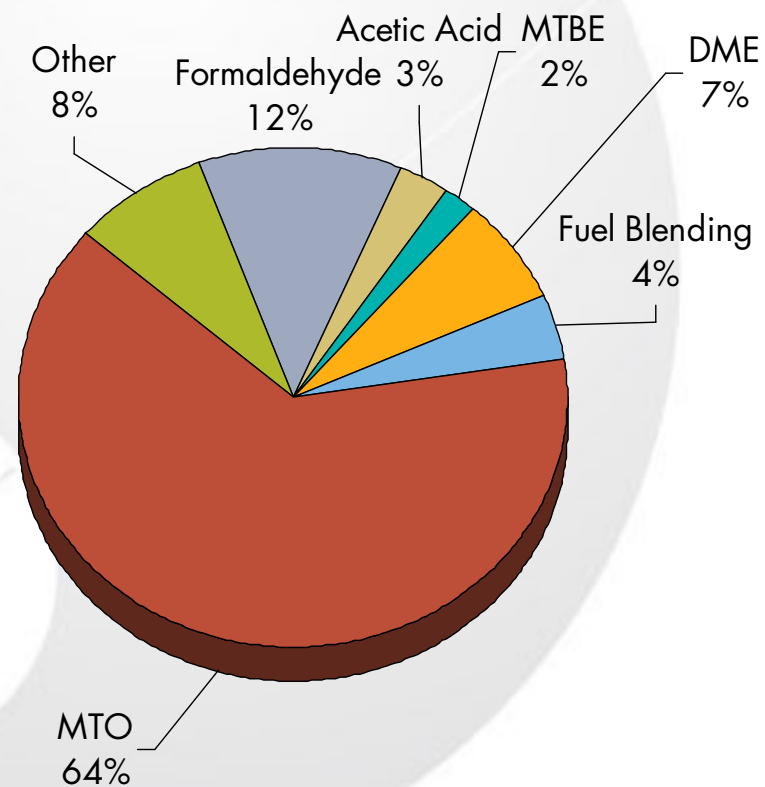
Source: Tecnon OrbiChem

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CHINA METHANOL DEMAND BY END-USE



**2013 Total
26-28 Million Tons**



**2020 Total
>70 Million Tons**

Source: Tecnon OrbiChem

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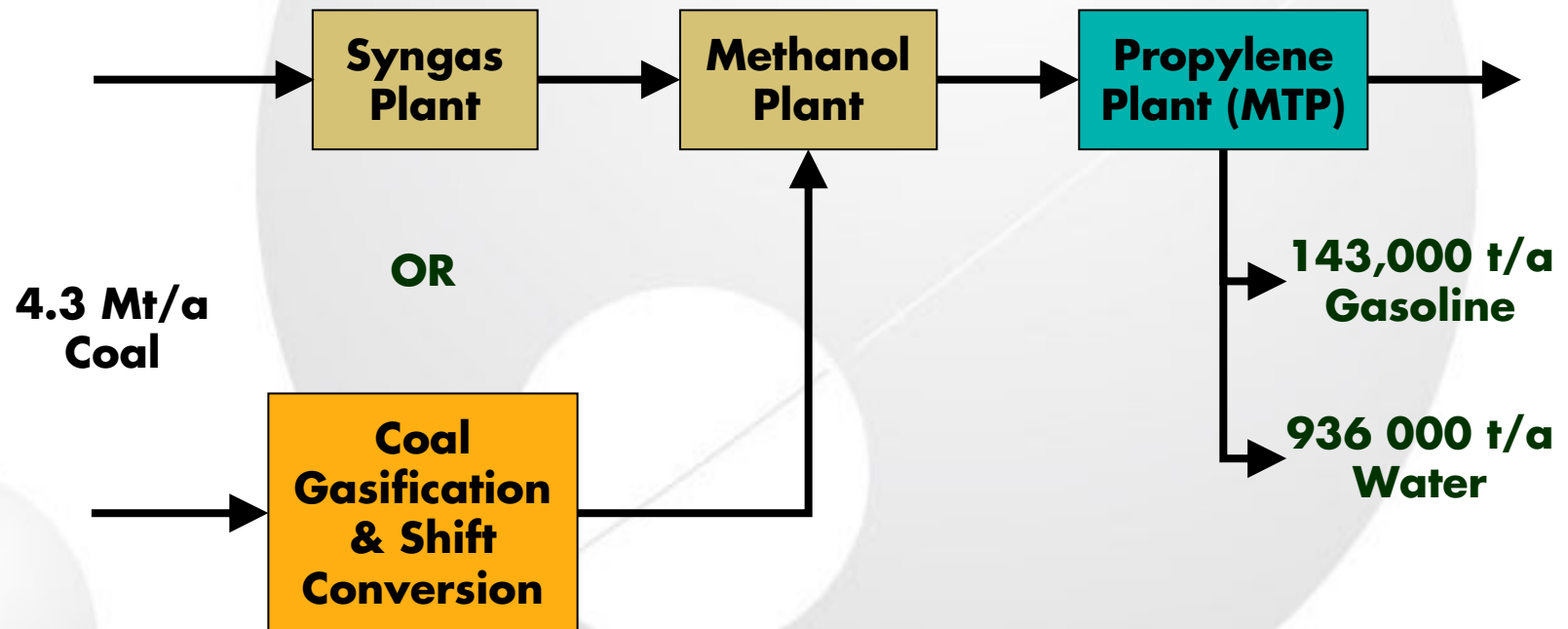
METHANOL-TO-PROPYLENE - LURGI MTP® PROCESS

**3.8 Mio Nm³/d
48 Mio mmBtu/a
Natural Gas**

**12.3 Mio Nm³/d
Syngas**

**1.7 Mt/a
Methanol**

**0.47 Mt/a
Propylene**



Source: Lurgi GmbH

APIC 2014 FEEDSTOCK REQUIREMENTS FOR MTP®

Natural Gas
2600 m³ =
100 mmBtu

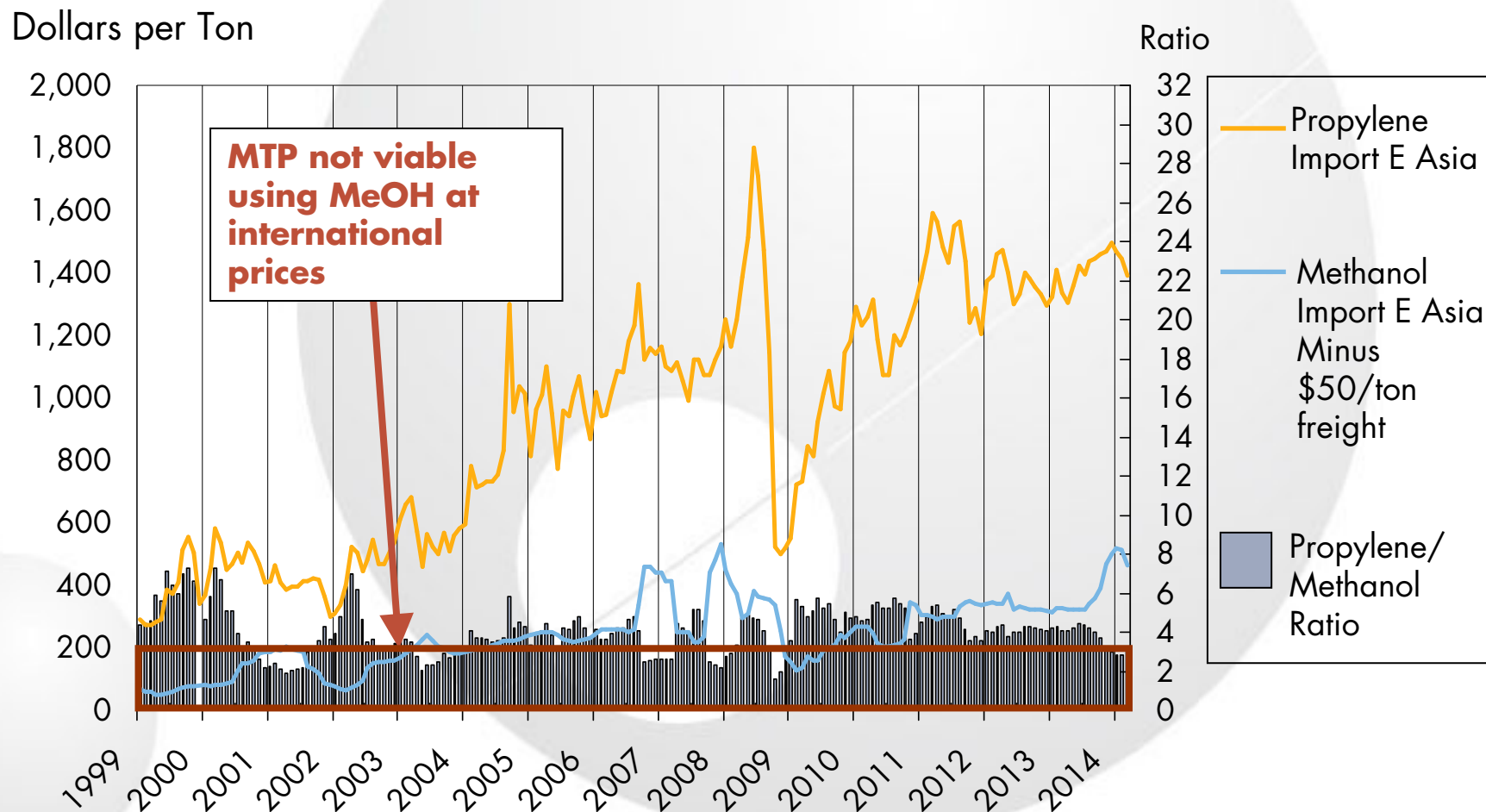
or

Coal
9.15 tons total
(6.25 tons feedstock
+ 2.90 tons fuel)

Methanol → **Propylene**
3.5 tons **1 ton**

Source: Tecnon OrbiChem

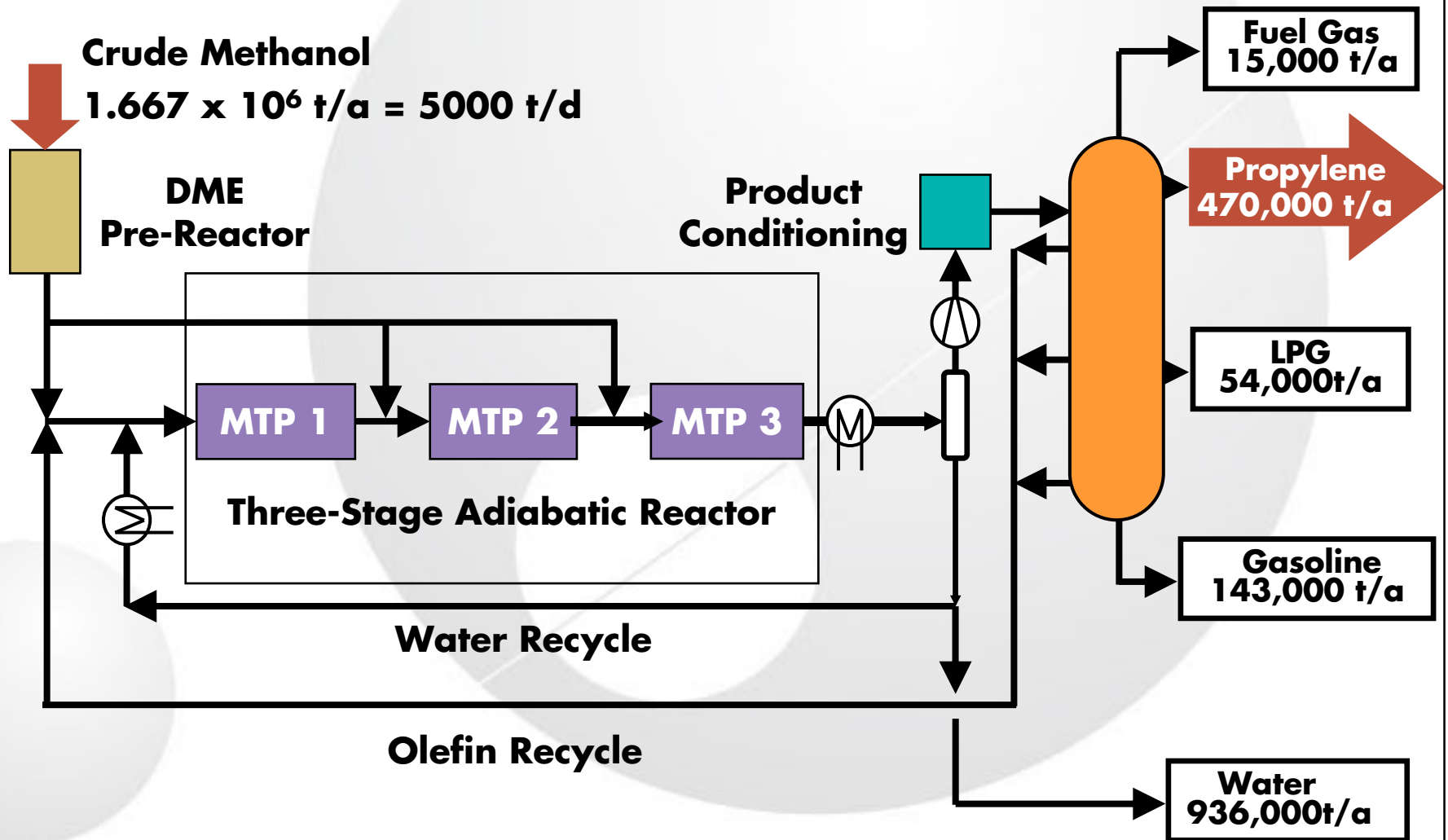
APIC 2014 VIABILITY OF MTP[®]



Source: Tecnon OrbiChem

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MTP[®] - SIMPLIFIED BLOCK DIAGRAM



Source: Lurgi GmbH

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MTP COMMERCIAL PROJECTS - CHINA

Datang International

- 1800 ktpa methanol from coal
- 470 ktpa MTP propylene (Lurgi)
- 456 ktpa polypropylene (Dow Unipol)
- Location: Xilinguole, Inner Mongolia, China
- Operating at 50-60% of capacity

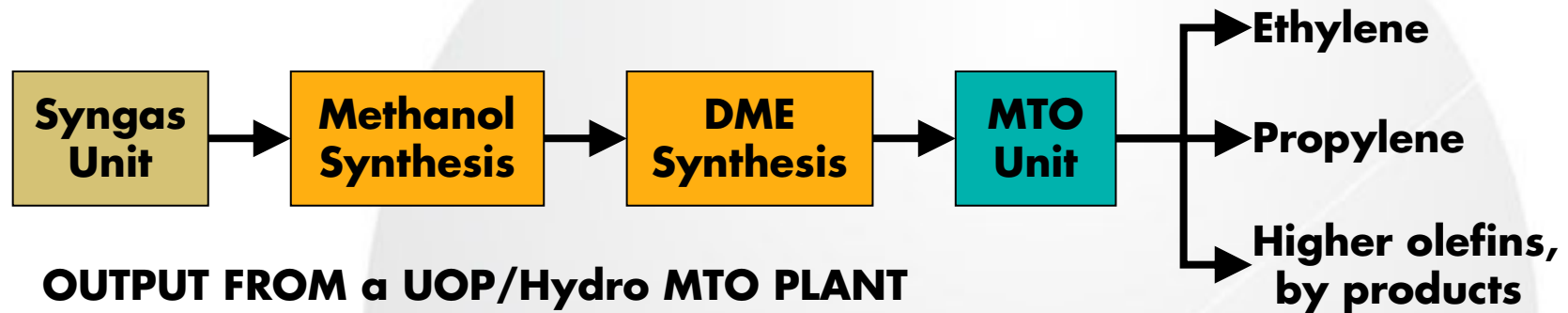
Shenhua Ningxia Coal Industrial Group

- 1670 ktpa methanol (Lurgi)
- 470 ktpa MTP propylene (Lurgi)
- 500 ktpa polypropylene (Lummus Novolen)
- Location: Ningdong, Ningxia province, China
- Start-up: MTP Sept 2010, polypropylene Q4 2010
- Generally operating at 70-80% capacity

Source: Tecnon OrbiChem

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METHANOL TO OLEFINS (MTO)



**OUTPUT FROM a UOP/Hydro MTO PLANT
Configured for 1:1 Ethylene : Propylene Ratio**

ktpa

INPUT

Natural gas ($2.1 \times 10^9 \text{ m}^3$)	1515
Methanol	2358

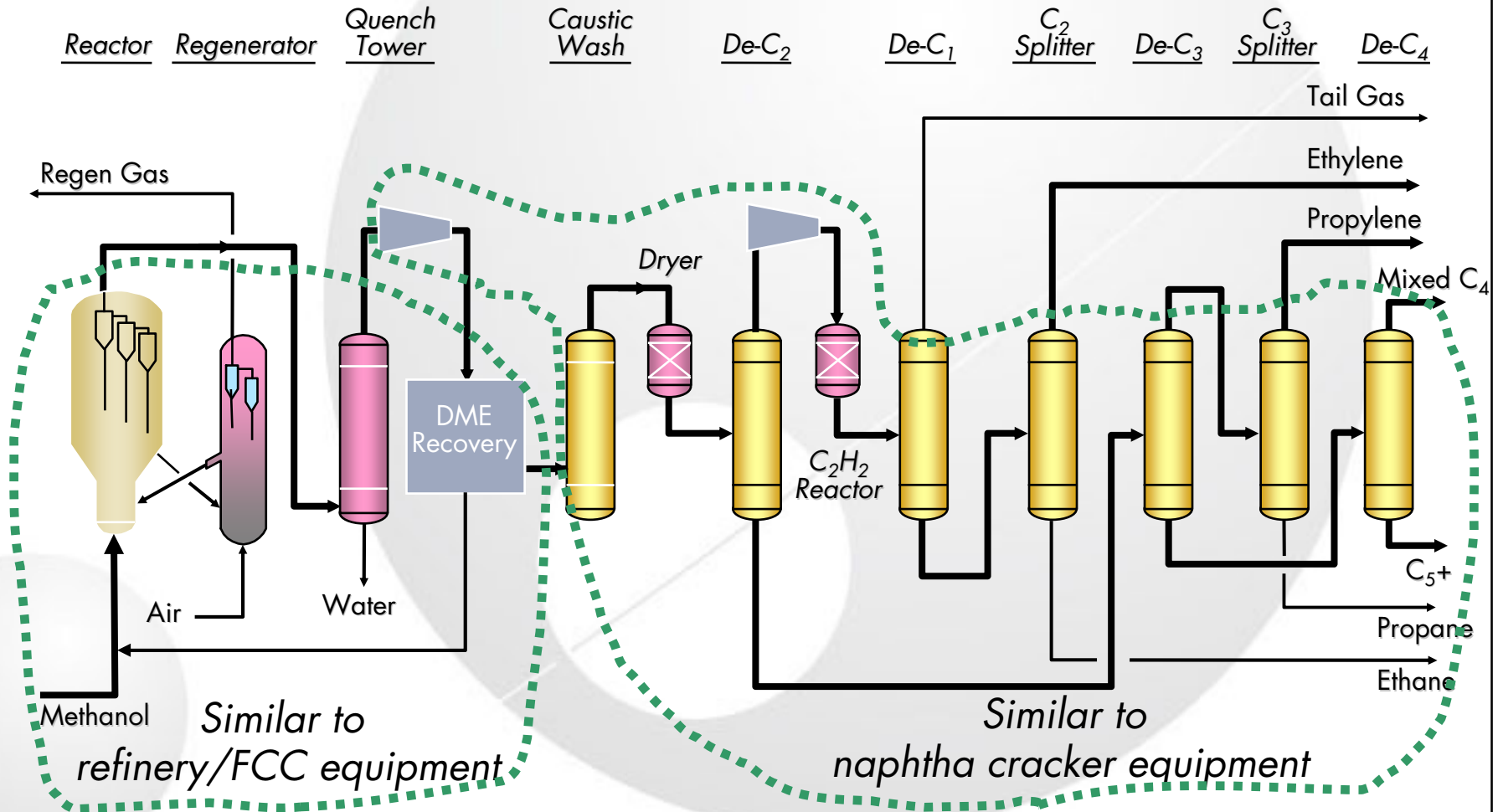
OUTPUT

Ethylene	400
Propylene	400
Butenes	123
C ₅ + hydrocarbons	46
Fuel gas	40
Other (water, CO _x , coke)	1349
Total	2358

Source: UOP

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METHANOL-TO-OLEFINS - UOP/HYDRO PROCESS

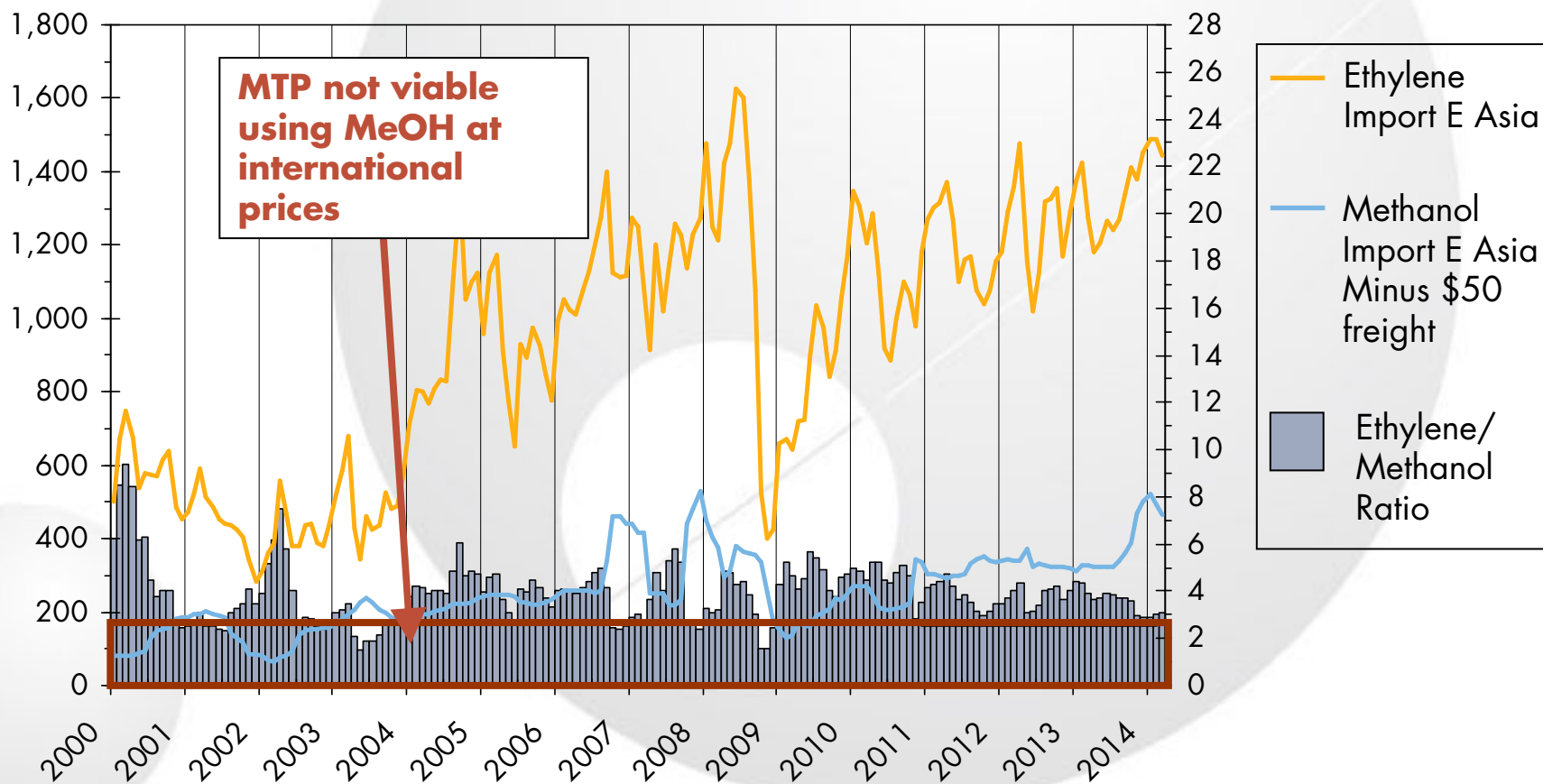


Source: UOP

APIC 2014 VIABILITY OF ADVANCED MTO

Dollars per Ton

Ratio



Source: Tecnon OrbiChem

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MTO COMMERCIAL PROJECTS - CHINA

Shenhua Baotou Coal to Liquid and Chemical

- GE gasification
- 1800 ktpa methanol, needing 3450 ktpa coal feedstock
- 600 ktpa DMT0 (SYN (Dalian Institute of Chemical Physics) + Lummus)
- 300 ktpa ethylene, 300 ktpa propylene
- 300 ktpa polyethylene (Univation)
- 300 ktpa polypropylene (Dow Unipol)
- Location: Baotou, Inner Mongolia, China
- Start-up: August 2010 all units

Sinopec Zhongyuan Petrochemical

- 600 ktpa SMT0 (Sinopec Beijing Yanshan Petrochemical); methanol bought
- 200 ktpa ethylene, 100 ktpa propylene
- 200 ktpa polyethylene, 100 ktpa polypropylene
- Existing 180 ktpa ethylene cracker and 60 ktpa polypropylene cannabilised
- Location: Puyang, Henan province, China
- Start-up: 2012

Source: Tecnon OrbiChem

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MTO COMMERCIAL PROJECTS - CHINA

Ningbo Heyuan Chemical

- 1800 ktpa methanol consumption
- 600 ktpa DMT0 [SYN + Lummus]]
- OCT Olefins conversion 90 ktpa propylene [Lummus]
- 300 ktpa polypropylene
- Location: Ningbo, China
- Start-up Jan 2013

Wison (Nanjing) Clean Energy

- 900 ktpa methanol consumption
- 300 ktpa MTO [UOP]
- Location: Nanjing, China
- Start-up 2014

Source: Tecnon OrbiChem

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CTO / MTO / MTP PROJECTS 2014 - 2015

<i>Company</i>	<i>Location</i>	<i>Details</i>	<i>Capacity (ktpa)</i>		<i>Start-Up</i>
			<i>Ethylene</i>	<i>Propylene</i>	
Pucheng Clean Energy	Pucheng, Shaanxi	CTO	300	400	Q1 2014
Yanzhou Coal	Ordos, Inner Mongolia	MTO	400	500	Q2 2014
Yulin Energy	Yuin, Shaanxi	CTO	300	300	Q2 2014
Qinghai Salt	Golmud, Qinghai	CTO	160	160	Q3 2014
Ningxia Baofeng	Ningxia, Shaanxi	CTO	300	300	2014
Jiutai Energy	Ordos, Inner Mongolia	MTO	300	300	2015
China Coal Mengda	Inner Mongolia	MTO	300	300	Q2 2015
China Coal Shaanxi	Yulin, Shaanxi	CTO	600	600	Q2 2015
Sinopec Zhijin	Zhijin, Guizhou	CTO	300	300	Q2 2015
Zhejiang (Xingxing) New Energy	Jiaxin, Zhejiang	MTO	300	300	Q2 2015
Huating Coal Group	Huating	MTP		200	2015
Shandong Yangmei Hengtong	Tancheng, Shandong	CTO	100	200	2015
Shandong Shengda	Tengzhou, Shandong	MTO	170	230	2015
Jiangsu Sailboat	Lianyungang, Jiangsu	MTO	300	300	2015
Sinopec Wanbei JV	Huainan	CTO	300	300	2015
SXYCPC - Yan'an Energy & Chem	Yan'an, Shaanxi	CTO	450	250	2015
Fude Chemical Energy	Changzhou, Jiangsu	MTO	500	500	2015

Source: Tecnon OrbiChem

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CONCLUSIONS

- Methanol has considerable potential to act as a new feedstock for olefins
- There is considerable potential for Methanol-to-Propylene plants, with two pioneering MTP[®] plants having come on stream in China in Q2/Q3 2010.
- Faster growth for propylene than ethylene demand, together with moves to lighter feedstocks for ethylene crackers, mean that alternative routes to propylene are needed.
- Methanol-to-olefin processes, which produce both ethylene and propylene, and especially the Advanced MTO process, offer even higher conversion of methanol to olefins. Four MTO plants already on line in China.
- Coal is the feedstock being used for the MTP and MTO plants in China. Some future plants will use imported methanol.
- Elsewhere natural gas is likely to be preferred; economics are very healthy where the natural gas is “stranded” and therefore cheap, but as the gap between natural gas and crude oil pricing has widened, even some non-stranded gas supplies are looking attractive.

Source: Tecnon OrbiChem



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