Impacts of feedstocks on the surfactants value chain – what's new?

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Agenda

1. Introduction to Nexant
2. Feedstock prices and impact on the Surfactants value chain
3. Ethylene Oxide issues/ changes in perspective
4. Bio-EO – is this the future?
5. Summary

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1. Introduction

Nexant provides expertise across the energy and chemicals value chain

Energy

POWER & RENEWABLES

- Grid Management
- Distribution Software
- Energy Efficiency
- Demand Side Management
- Renewables
  - Solar
  - Biomass
  - Municipal Waste
  - Wind
  - Clean Coal

GAS

- Gas Monetization
- LNG
- Gas Pipelines
- Regulatory Frameworks

DOWNSTREAM OIL

- Petroleum Refining
- Storage & Distribution
- Biofuels
- Oxygenates
- Coal to Liquids
- Gas to Liquids
- Base Oils
- Lubricants

Chemicals

C1 CHEMICALS & FERTILIZERS

- Ammonia
- Urea
- Melamine
- Ammonium Nitrates
- Phosphate & NPK Fertilizers
- Methanol
- Formaldehyde
- Acetyls
- Other syngas derivatives

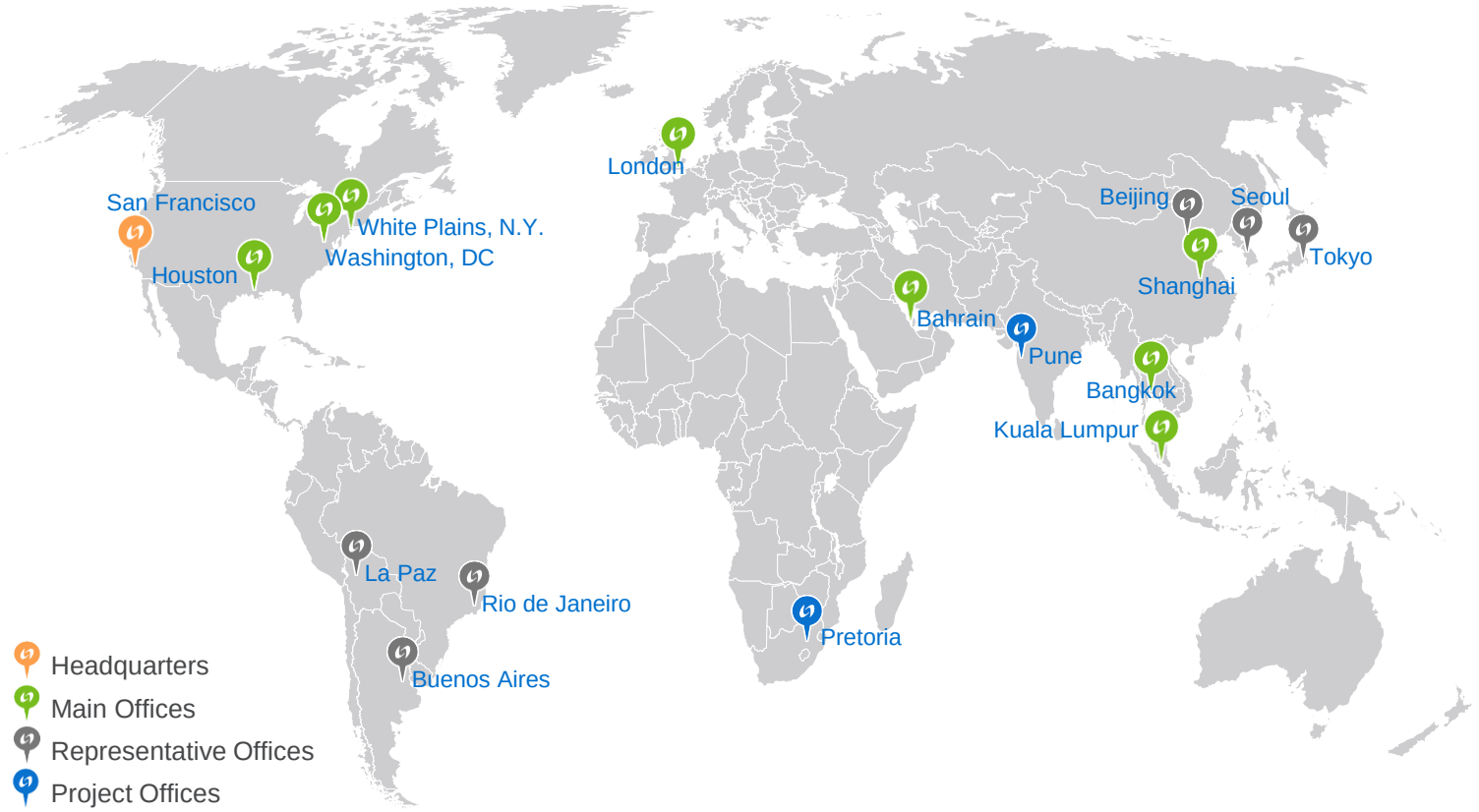
PETROCHEMICALS & POLYMERS

- Olefins
- Aromatics
- Polyolefins
- Vinyls
- Styrenics
- Polyesters
- Polyamides
- Acrylates
- Rubbers
- Other olefin and aromatic derivatives

INTERMEDIATE & SPECIALITY CHEMICALS

- **Surfactants**
- **Oleochemicals**
- **Engineering & Speciality Polymers**
- **Coatings, Adhesives, Sealants & Elastomers (CASE)**
- **Polyurethanes**
- **Resins**
- **Biochemicals**
- **Speciality & Fine Chemicals**

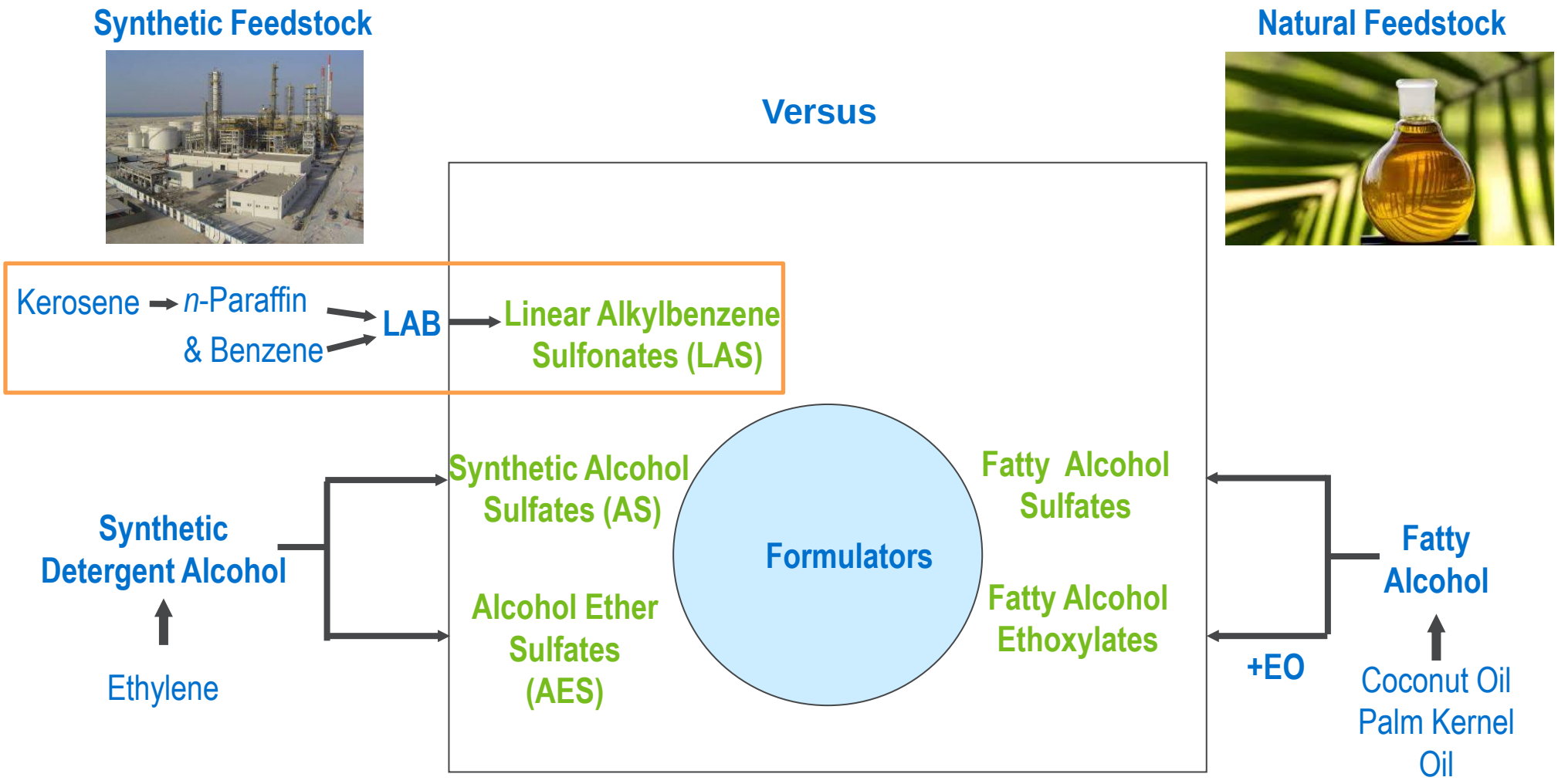
Nexant provides global knowledge and regional expertise in Energy and Chemicals Industry



Nexant E&CA has over 120 knowledgeable and responsive consultants that focus on energy and chemicals, providing global coverage and regional expertise

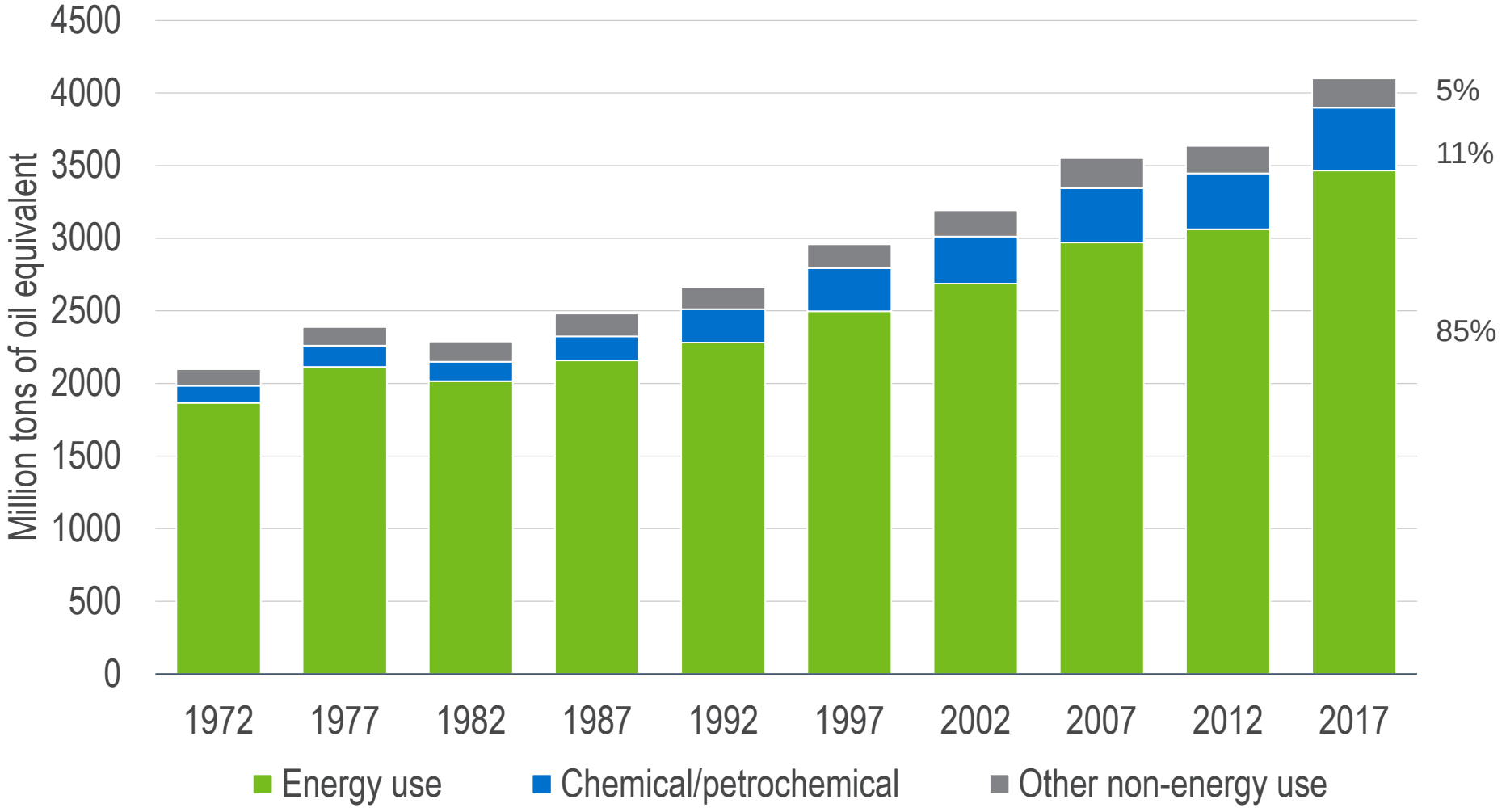
2. Feedstock prices and impact on the Surfactants value chain

Feedstocks for Surfactants



Consumption of crude oil products into chemicals has increased gradually, but remains a minor application compared to energy use

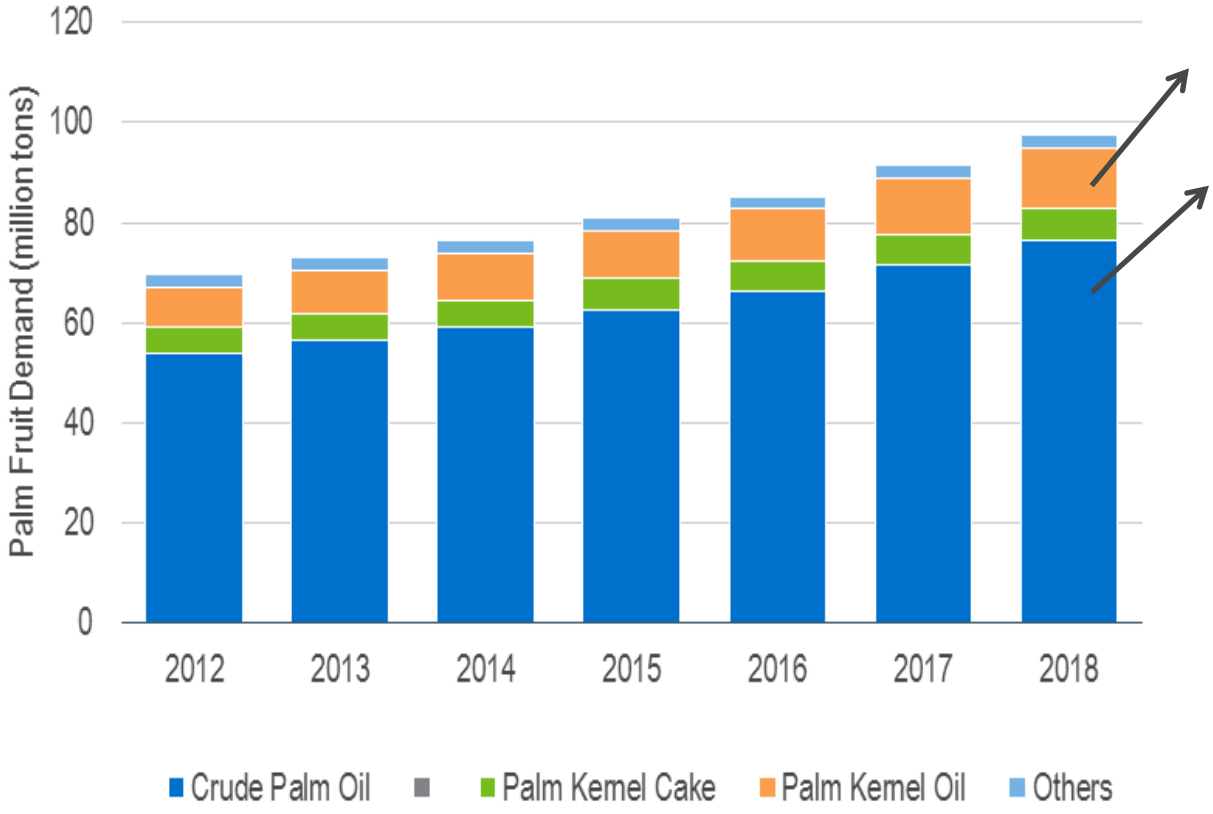
Global Consumption of Crude Oil Products by Application



Source: IEA Energy Balances & Statistics 2015

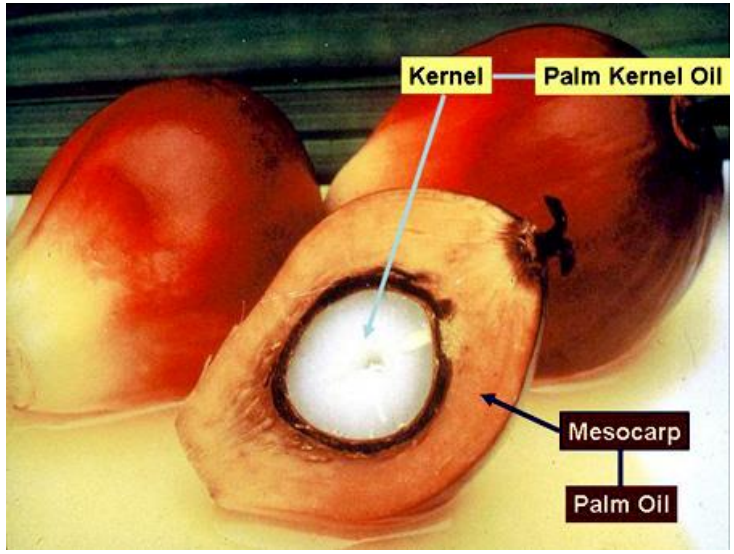
Palm Kernel Oil (PKO), the main feedstock for natural surfactants in the personal care business, is essentially a by-product of palm oil production and is a relatively small end-use (~10%)

Global Demand for Palm Fruit



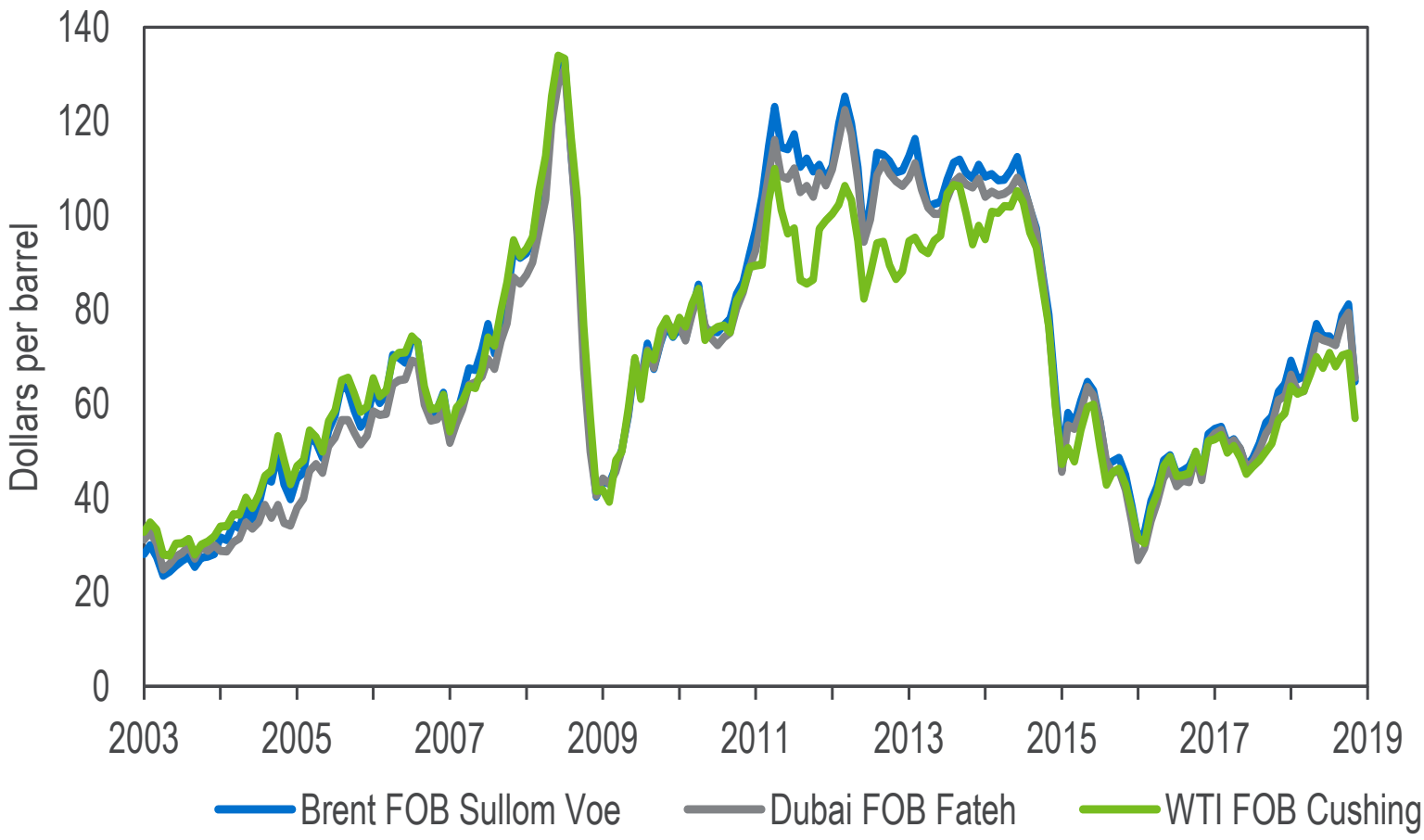
Used in Detergent Alcohols

Mainly edible oils and biofuels



Crude Oil Price Volatility – what is the new norm?

Global benchmark crude oil pricing



2019/20 → ??

Many diverse factors influence supply and demand for crude oil, consolidating to drive price reductions

Strengthening Demand or Shortening Supply

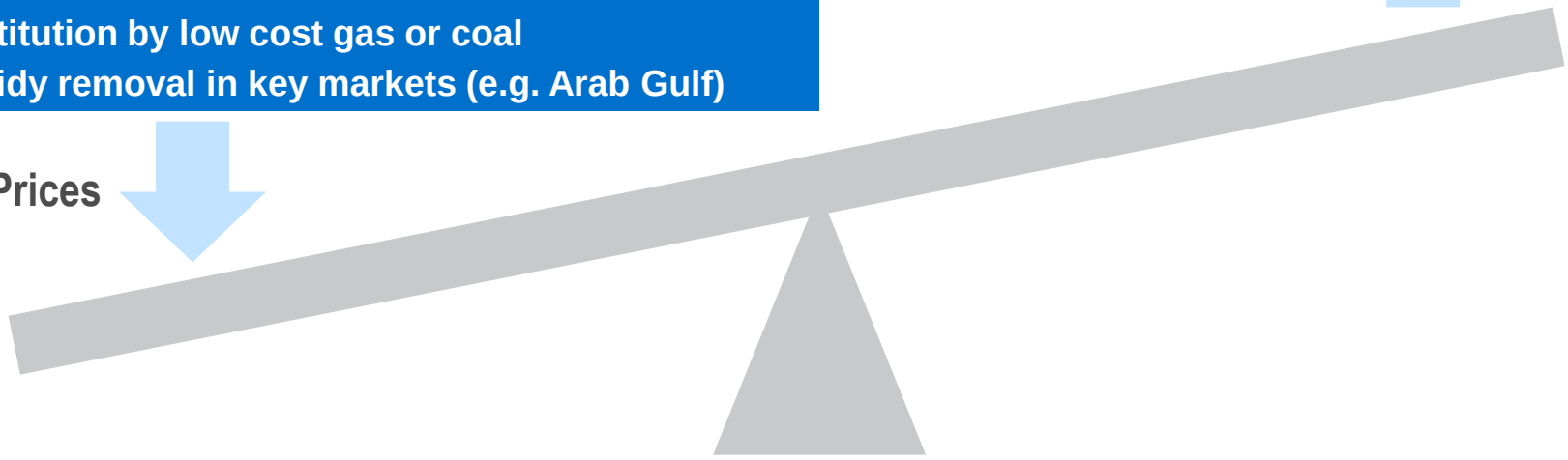
- Strong economic environment
- US dollar weakness
- Low inventories
- Political uncertainty, year of supply disruption
- Limited spare capacity
- Growing need for OPEC oil supplies
- Disciplined adherence to OPEC production quotas

Higher Prices

Weakening Demand or Lengthening Supply

- Weak economic environment – Brexit impact?
- Strengthening US dollar
- Slowing demand growth and accelerated supply (Iran)
- Lack of adherence to OPEC production quotas
- Energy efficiency initiatives
- Switch to renewable, low carbon fuels
- Substitution by low cost gas or coal
- Subsidy removal in key markets (e.g. Arab Gulf)

Lower Prices

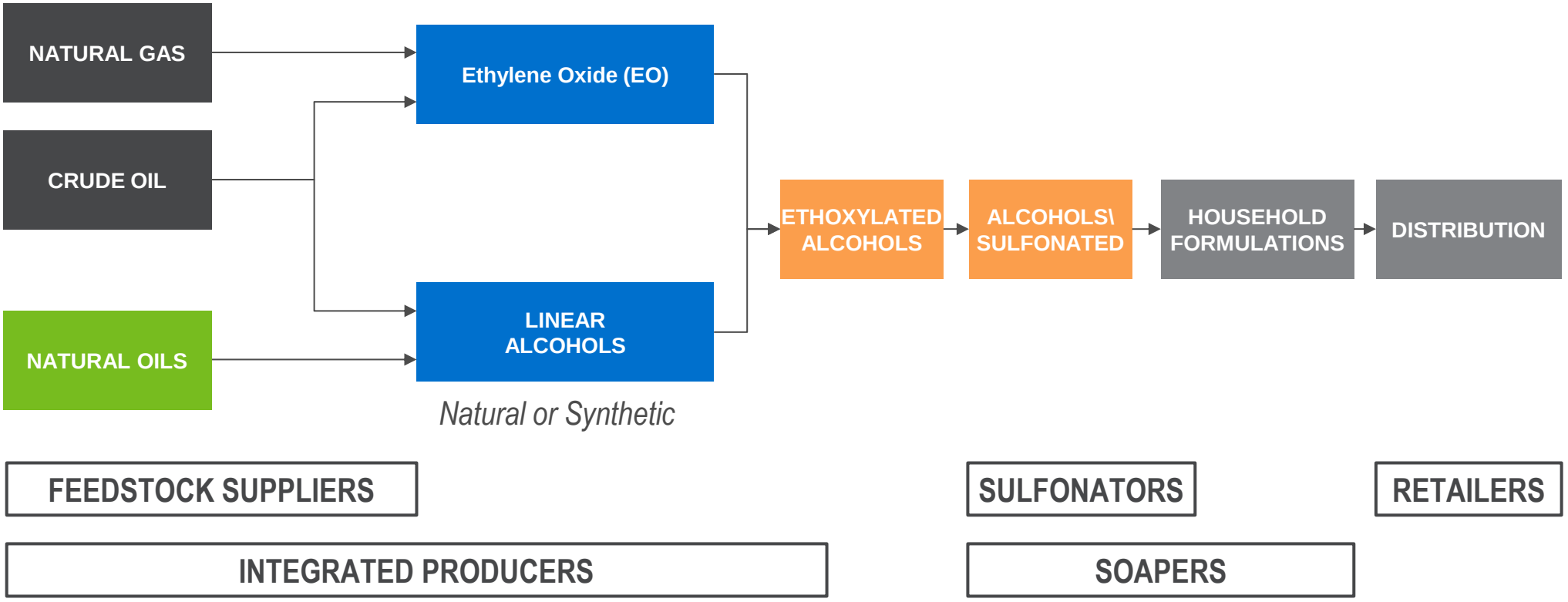


Each feedstock to formulators has its pressures

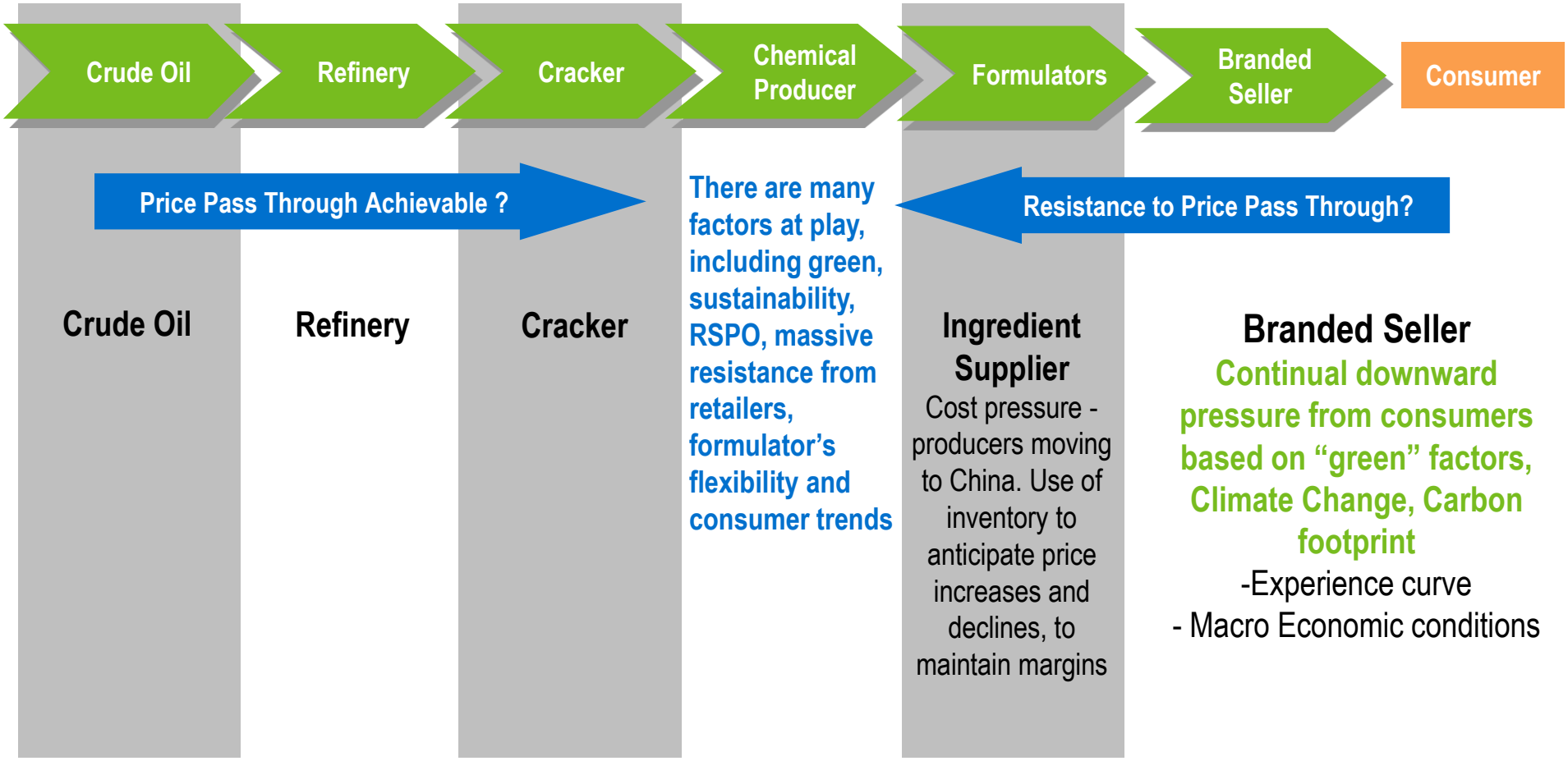
- Supply/demand of palm oil
- Price of competing vegetable oils
- Weather patterns
- Import policies
- Taxation/ import duty changes
- Consumer pressures

3. Ethylene Oxide issues

Simplified Typical Surfactants Value Chain



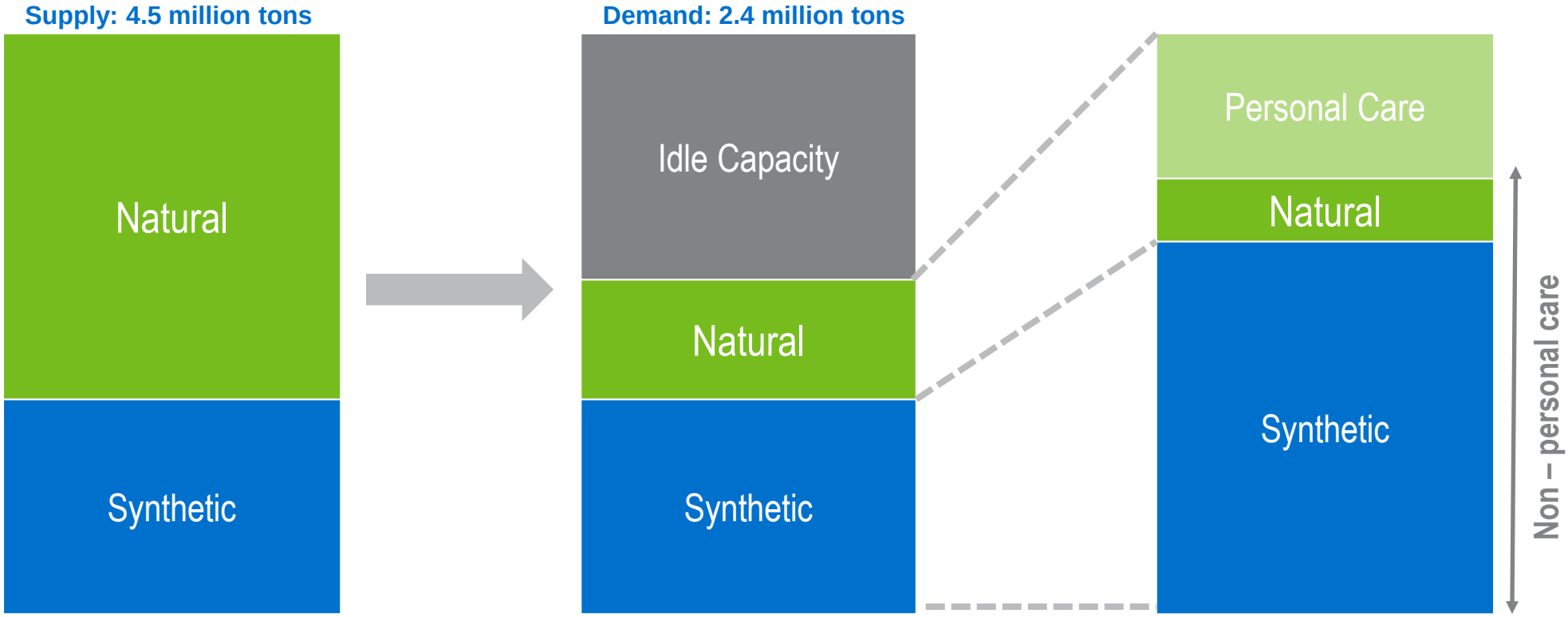
The Chemical Producer is caught between the oil/petchems players and the big brand consumer marketers



Chemical Producers are increasingly influenced by consumer pressures

Currently synthetic producers are gaining market share from natural producers. Naturals still dominate personal care applications due to end user consumer pressure

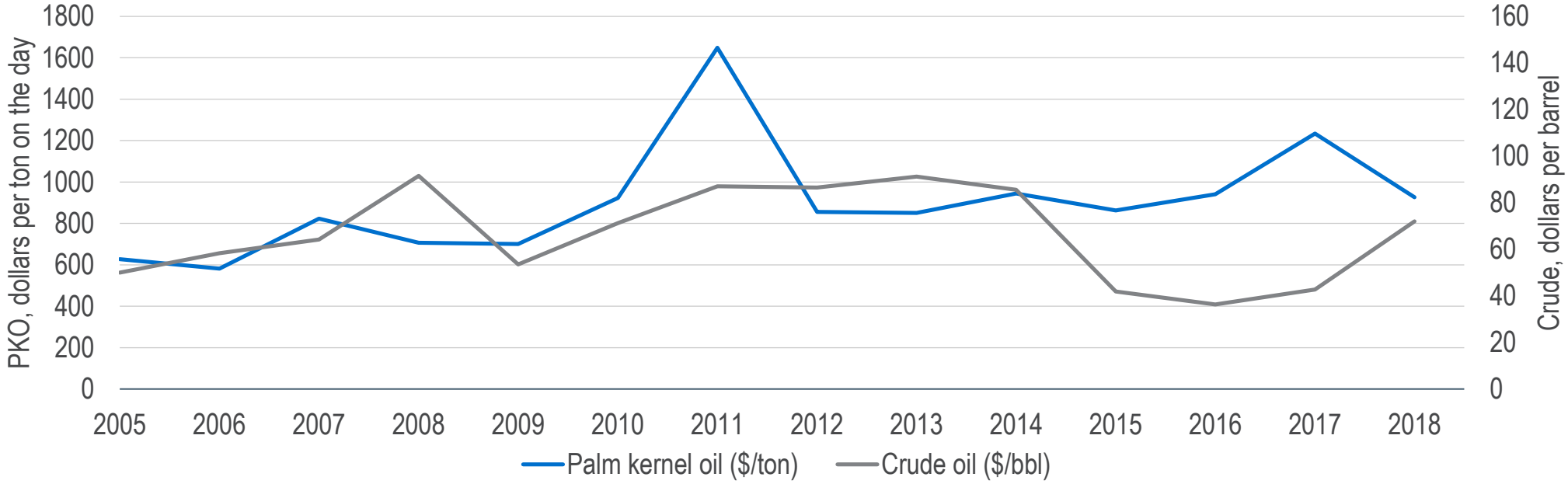
Detergent alcohol producers



Globally installed capacity is split 75/25 between natural and synthetic based plants

25 percent of detergent alcohol demand is consumed by the personal care sector

The relative pricing between natural and synthetic feedstocks dictates the formulator's demand, except where the end-use applications are dependent on consumer pressures

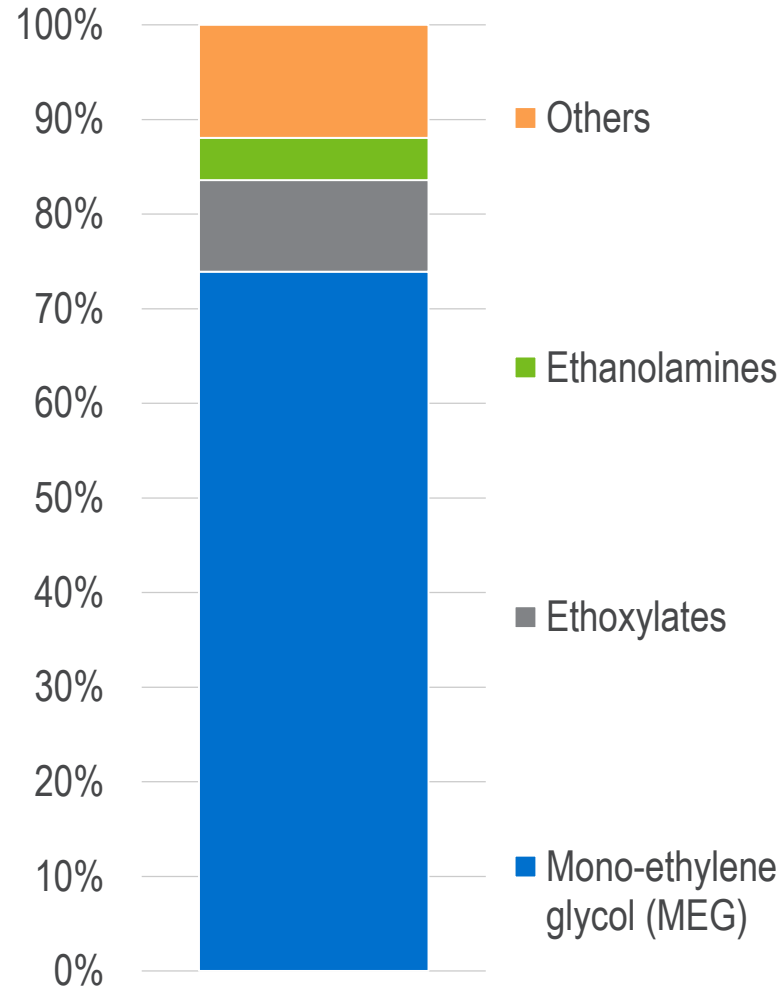


Market Demand

Performance is often the key differentiator, not just the price

Global Ethylene Oxide and Downstream Markets by end-use

Ethylene → Ethylene Oxide (EO)



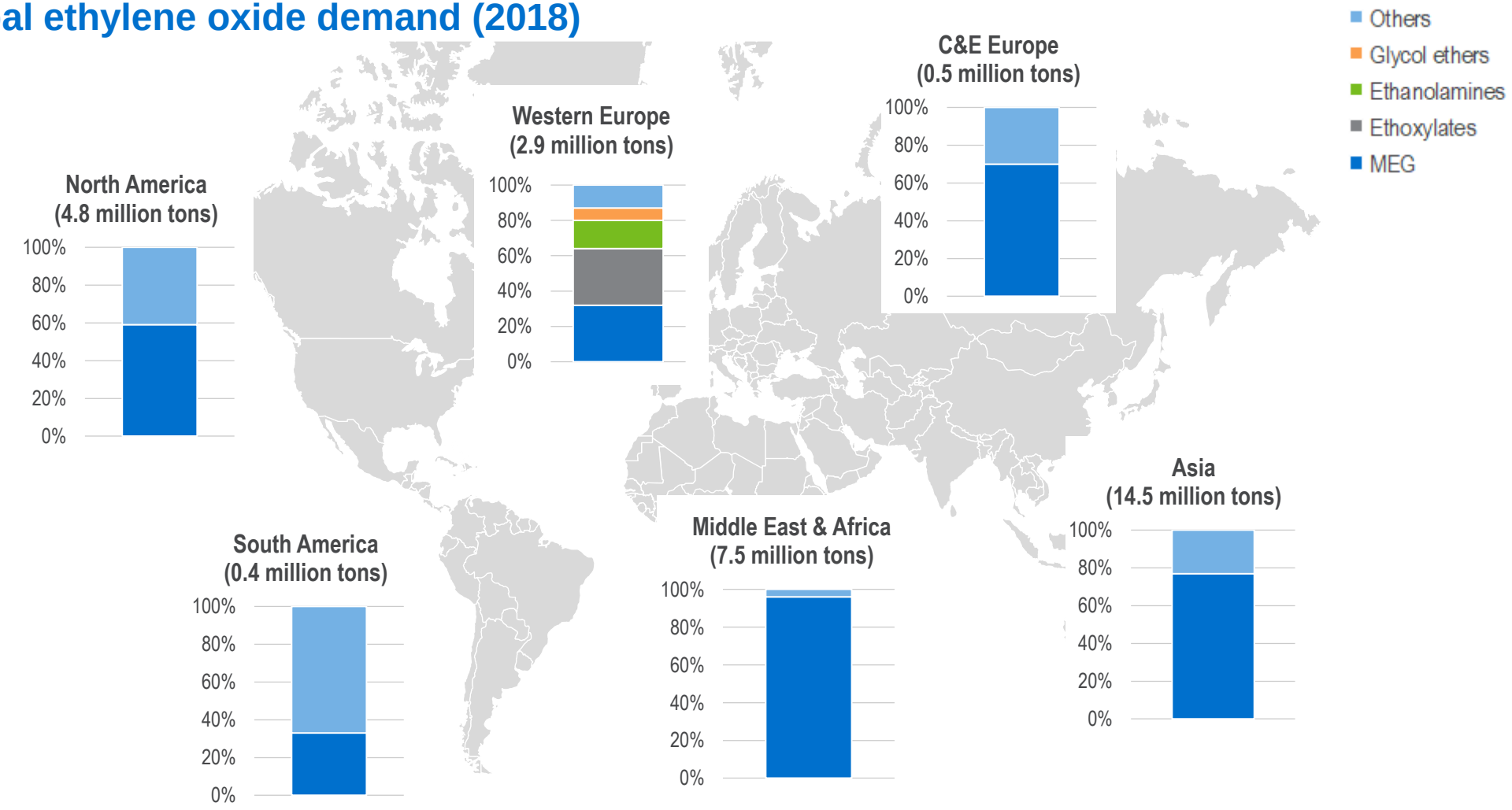
Major application

Coatings, Lubricants, Pharmaceuticals etc.	
Gas scrubbing	CO_2, H_2S
Surfactants	
PET Fibre / Bottle	

Global Ethylene Oxide Demand, 2018
(volume – 30.6 million tons)

In Western Europe and America, demand for EO is more varied unlike other regions which are heavily focused on MEG

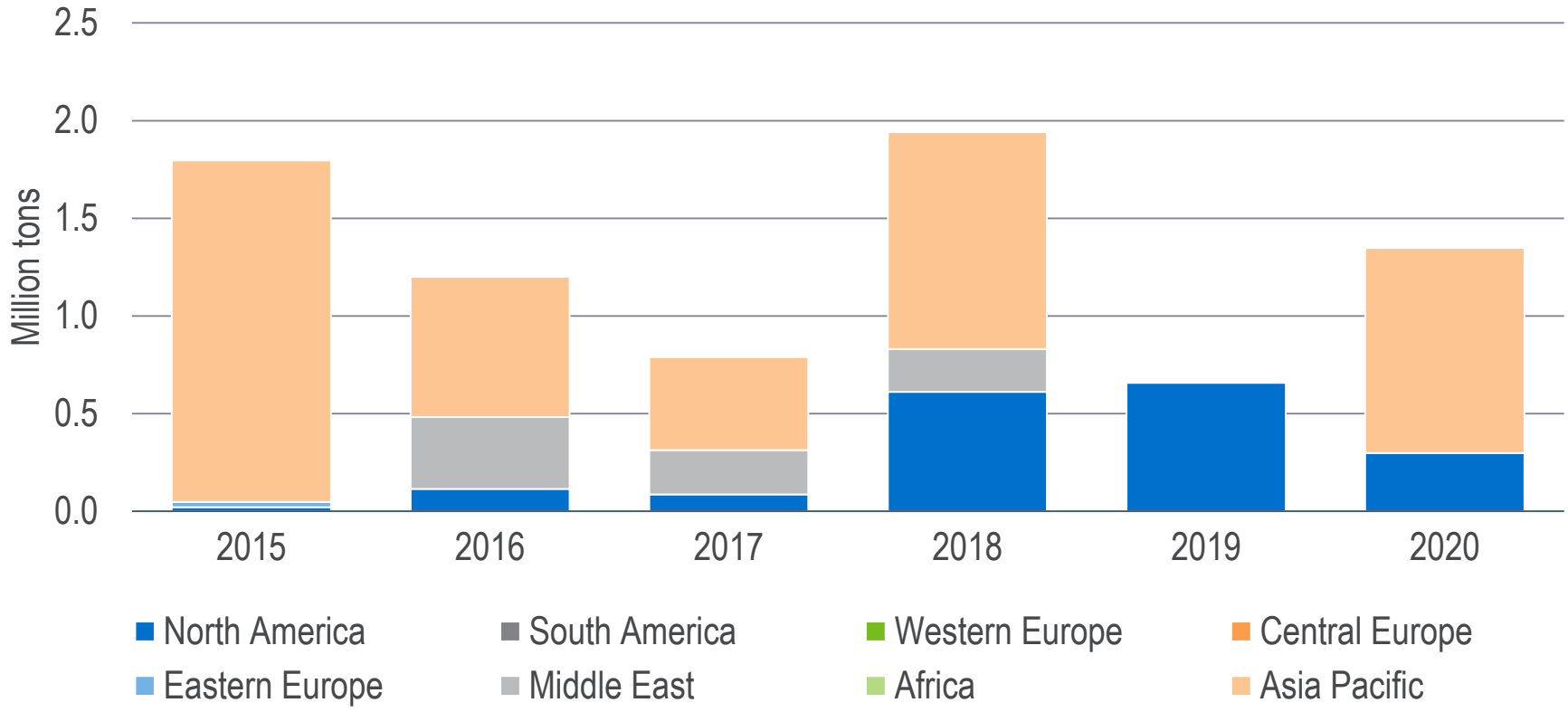
Global ethylene oxide demand (2018)



Areas with access to relatively cheap feedstock (the Middle East) or high PET demand (Asia Pacific) have sparked new construction

No EO capacity additions in Europe in recent years but this is likely to change with INEOS and BASF announcements

Global Ethylene Oxide Capacity Additions by region, 2015-2020



EO recent capacity addition announcements by INEOS and BASF in Western Europe are not shown in the above list.

Capacity additions in Western Europe will be brownfield and likely to continue to be so in the near term

BASF

- In September 2018, BASF announced a stepwise capacity increase of its production plant at Verbund, Antwerp for alkoxylation. The first additional capacities will be available from as early as the 3rd quarter of 2018. Overall, the company plans to step up their alkoxylation capacities at the Antwerp site by up to 25 % by 2021.

INEOS

- Increasing ethylene supply from INEOS supports the outlook for EO production in Western Europe. The is made possible because of their $2 billion investment in their shipping program for importing ethane and LPG from the U.S. in large quantities.

- In the same month, INEOS also announced EO capacity expansions in Antwerp and Lavera in WE (total €200 million) and in North America (270 000 tons per year).

- A sixth alkoxylation unit in Antwerp was scheduled to start up at the end of 2018, along with a 2,000 tonne expansion of ethylene oxide (EO) storage capacity at the site.

Beyond 2020, interest in bringing new EO capacity appears to continue to be focused in North America, Middle East and Western Europe

Global Ethylene Oxide Capacity Additions by region, 2018-2023

(000 tons per year)

		2017	2018	2019	2020	2021	2022	2023	Process
North America									
Lotte Chemical Corporation	Lake Charles, LA	-	-	-	-	560	560	560	Integrated EO/MEG
MEGlobal	Freeport, TX	-	-	302	600	600	600	600	Integrated EO/MEG
Sasol	Lake Charles, LA	-	25	300	300	300	300	300	Direct oxidation
Asia Pacific									
CSPC	Huizhou, Guangdong	-	505	505	505	505	505	505	Integrated EO/MEG
Sinopec Zhanjiang	Zhanjiang, Guangdong	-	-	-	250	250	250	250	Direct oxidation
Sinopec Zhanjiang	Zhanjiang, Guangdong	-	-	-	320	320	320	320	Integrated EO/MEG
Petronas	Pengerang	-	-	-	480	480	480	480	Integrated EO/MEG
Middle East									
Bushehr Petrochemical Co	Bandar Assaluyeh	-	-	-	-	440	440	440	Integrated EO/MEG
NPC (Iran)	Hamadan	-	-	-	-	120	120	120	Direct oxidation
SABIC	Al Jubail	-	-	-	-	-	560	560	Integrated EO/MEG
Western Europe									
BASF	Antwerp	-	-	*	*	112	112	112	Direct oxidation
INEOS	Antwerp and Lavera	-	-	*	*	*	*	*	Direct oxidation

Capacity size addition not announced

So where will ethylene oxide supply be based?

Key benefits
Low cost ethylene

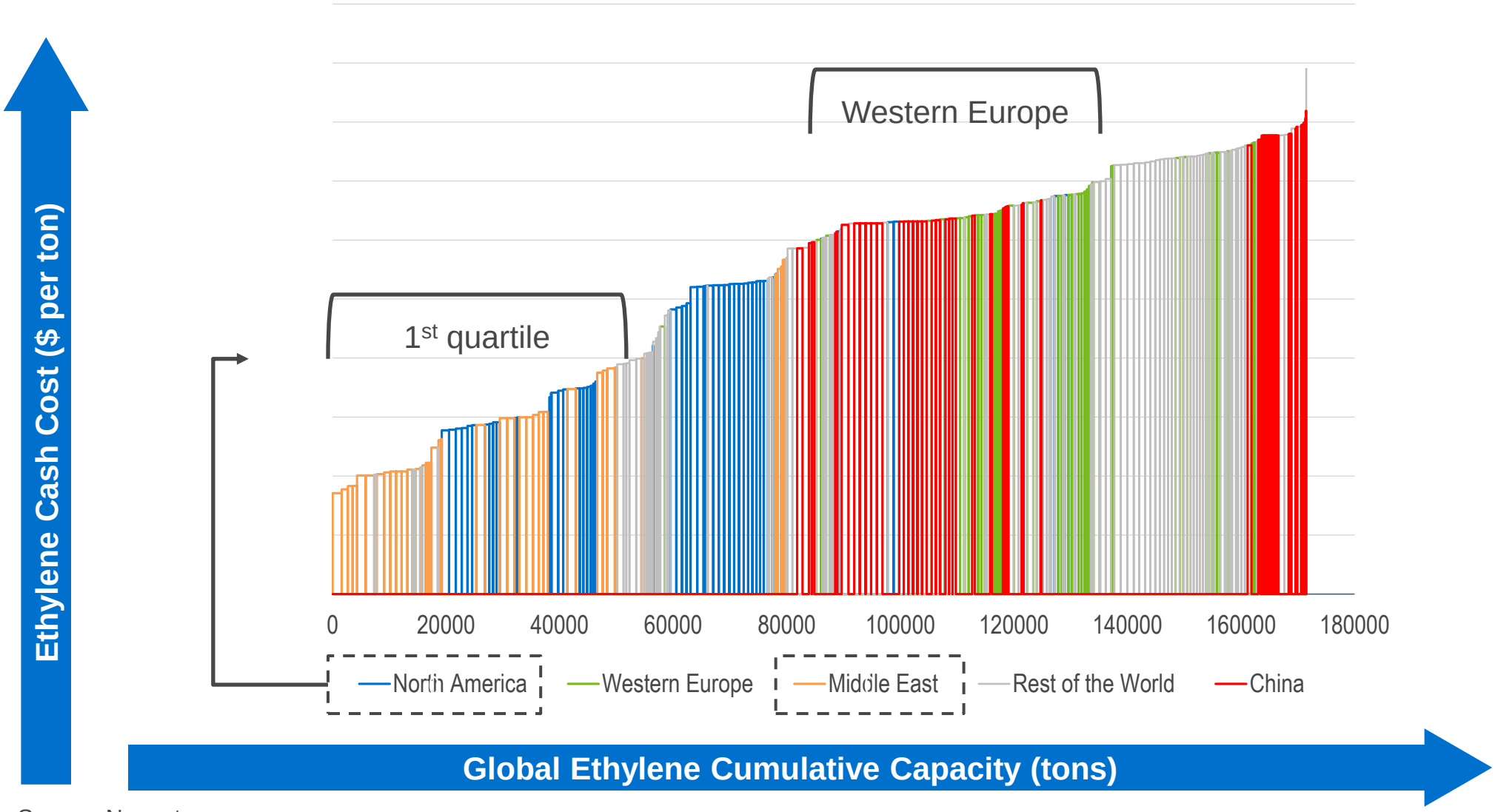
Key downsides
Likely situated far away from certain markets

Key benefits
More responsive to market changes

Key downsides
High EO freight costs

EO capacity additions are attractive in regions with low cost ethylene feedstock OR….

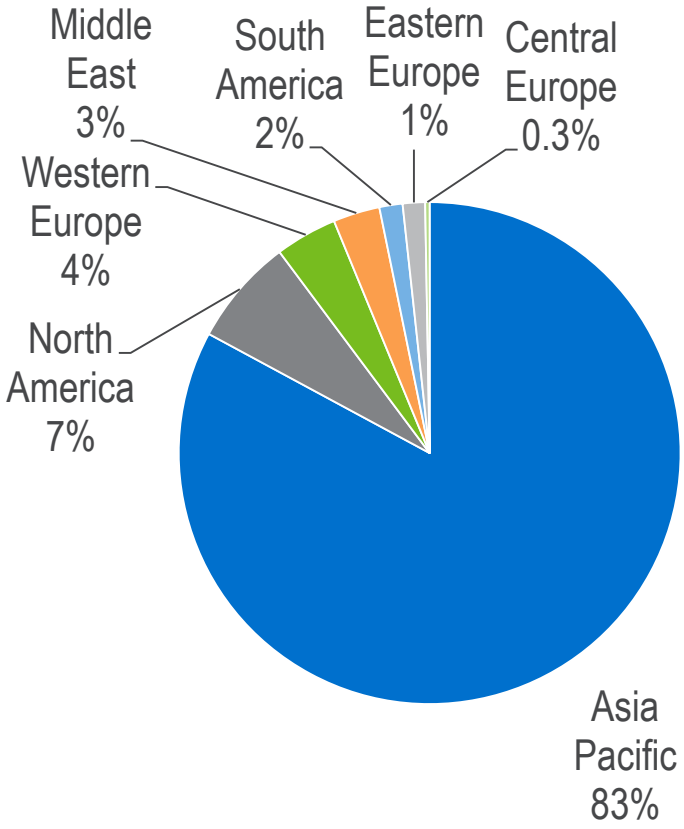
Global Ethylene Cost Curve (2018)



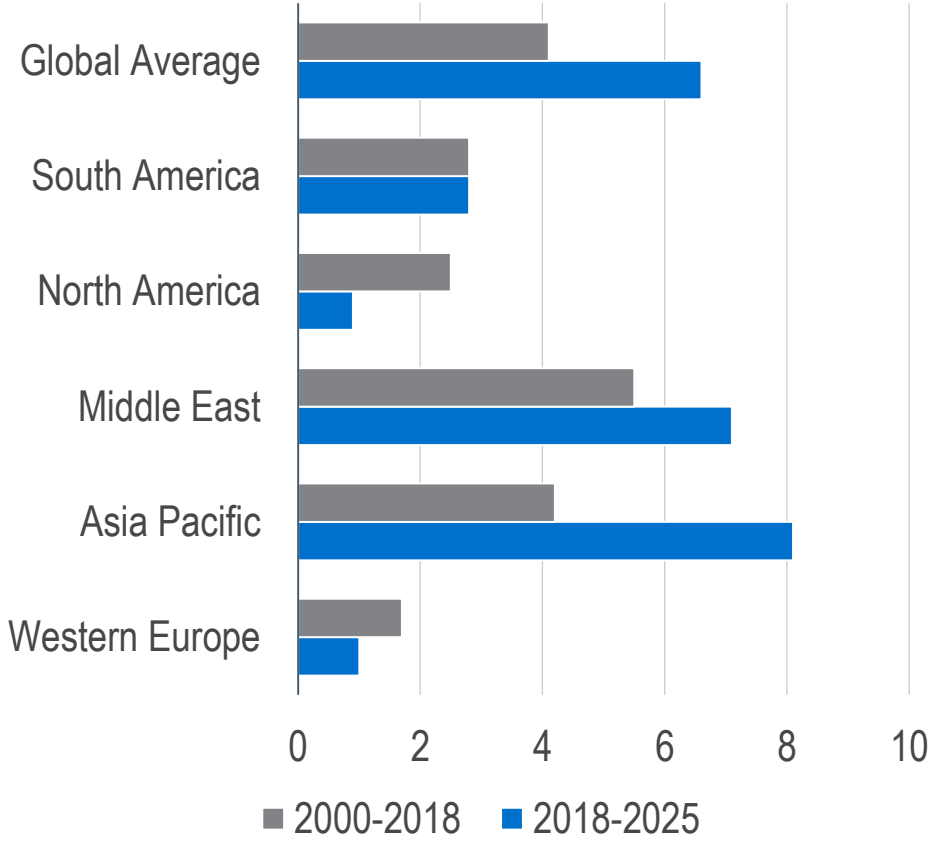
Source: Nexant

In regions where the key market, PET, is located – i.e. Asia Pacific

Global PET Demand, 2018
(volume – 87.3 million tons)

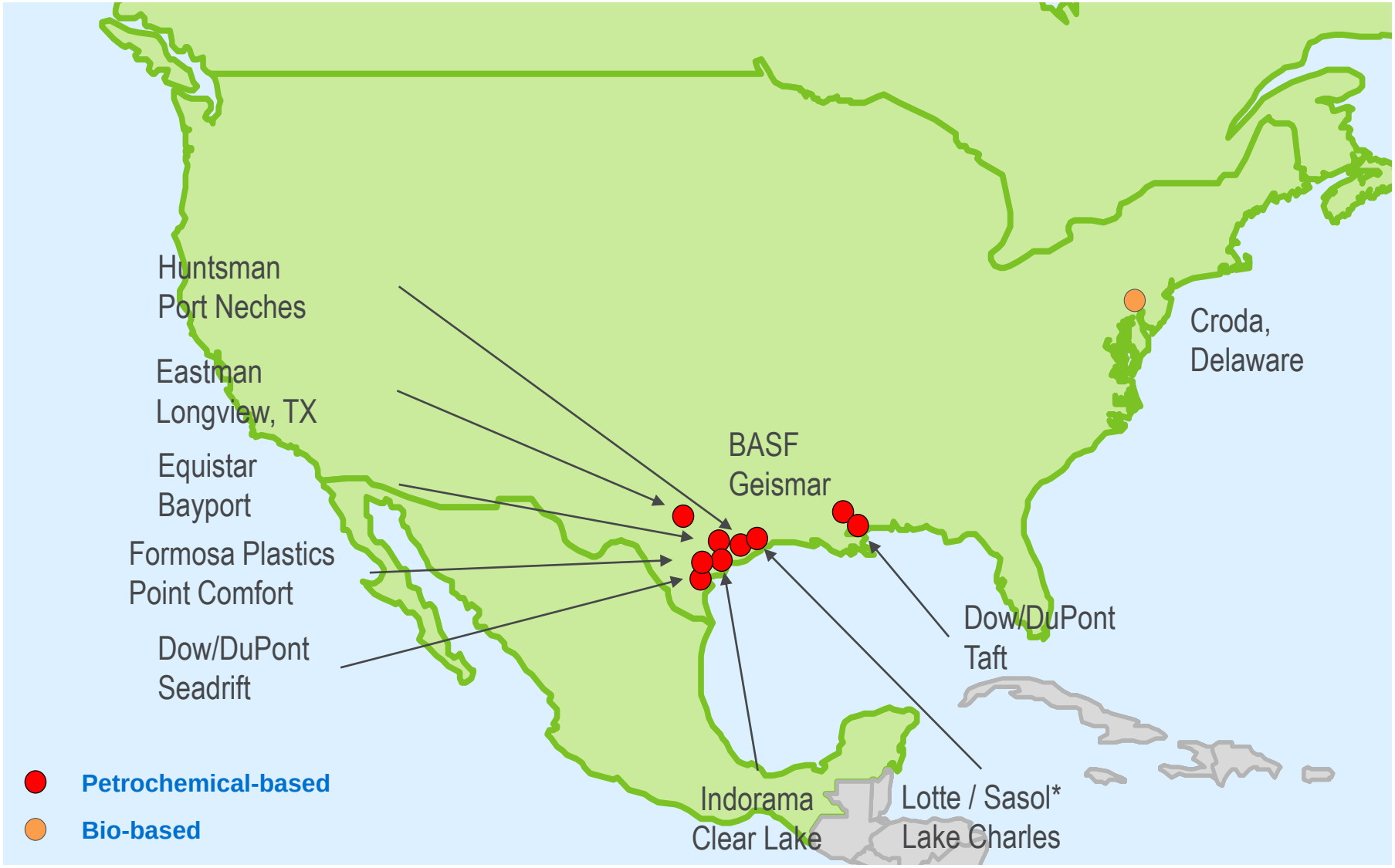


Regional PET Demand Growth
(percent volume growth)



4. Alternative Sources of EO – Is Bio-EO the future?

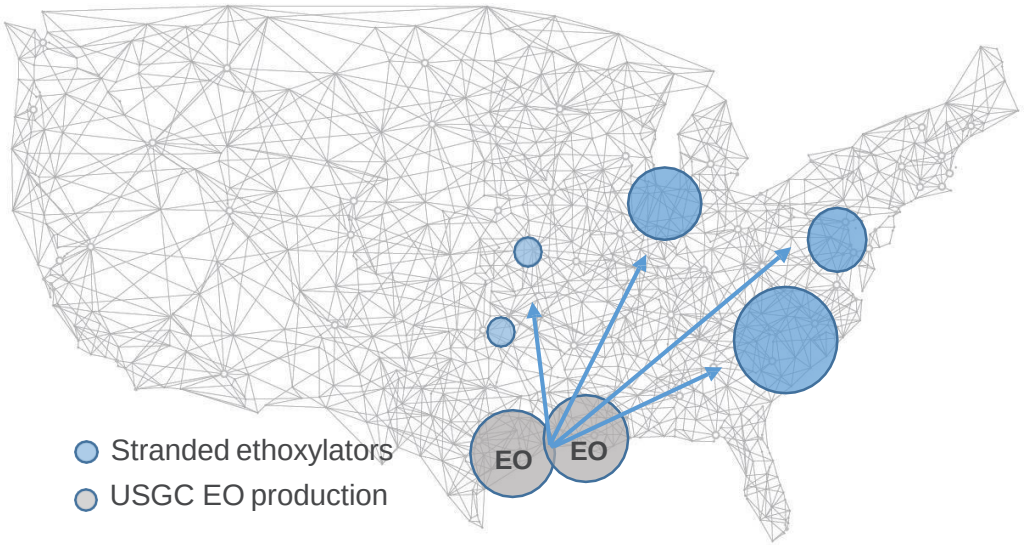
Location of some Ethylene Oxide Plants in the USGC – Croda being an exception as bio-based and not in USGC

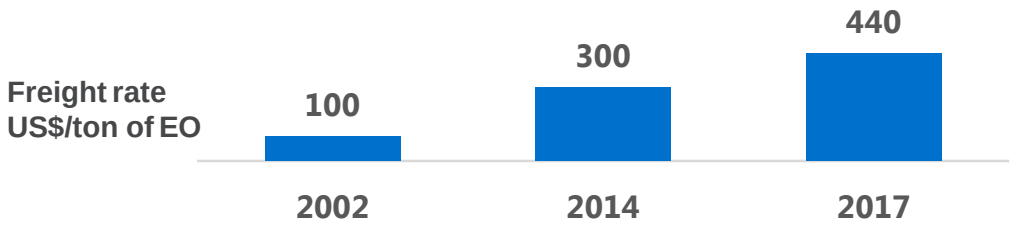


* Ongoing investment decisions

Not all EO producers and ethoxylators in the U.S. are integrated and thus face increasing freight costs for EO delivery

EO Transportation





Source: Oxiteno

EO is increasingly difficult to ship by rail

- Flammable and highly reactive, therefore costly to ship
- EO railcars require special safety precautions
- Supply of railcars is limited and regulations have become more restrictive

EO transportation cost from US Gulf to NE

- EO transportation costs have increased 10-20% every 6 months
- For non-US Gulf players, freight represents around 30% of the EO cost
- Average EO content in an ethoxylated product is ~65%

Specialty surfactants – what strategy could they adopt?

Producers that focus more on personal care market such as Croda have a high incentive to go fully bio-based

Naphtha/ Natural gas

Ethylene

$+O_2$

Ethylene Oxide

Ethoxylates

Biomass

Bio Ethanol

$-H_2O$

Bio Ethylene

$+O_2$

Bio-based EO means ethoxylation can now **increase** the renewable content of materials

Bio-based EO is equivalent in performance to synthetic material

No sacrifice in performance for choosing the more renewable material!

"Green EO" has some long-commercialized steps with low technical risks

CO_2

Sugarcane uses sun's energy to metabolize CO_2*

CH_3-CH_2OH

In the *distillery*, sugar juice is fermented and distilled

CH_2=CH_2

Dehydration transforms *ethanol to ethylene*

Green EO

Ethylene is oxidised to EO

EO to surfactants

* ***Sugarcane is shown, but any ethanol will suffice — fermentation, algae based, or thermochemical***

New ECO Ethoxylates

- 100% renewable
- 100% bio-based*
- Performance identical to petro-based options
- Lower carbon footprint than petro chemically derived ingredients
- USDA BioPreferred Program 3rd party certification
- RSPO Supply Chain Certified via Mass Balance**

** Calculated using prEN16785-2 which is to be validated by carbon 14 testing (ASTM D6866)*

*** Products containing palm derivatives*

Source: Croda

Conclusions

Impacts of Feedstocks on Surfactants value chain

Global Developments

- Ethoxylates remain the key non-MEG EO derivative, leading investment in almost all areas.
- Higher crude oil prices, and falling prices for natural oils impacted on the synthetic versus natural ethoxylates equation in 2018.
- US producers still benefit from low-cost ethylene, while select synthetic alcohol ethoxylators in Europe are building for internal use. The bulk of natural alcohol production in Asia became more competitive.

Bio EO

- Business case to make a Bio EO plant in situ, is this specific to the speciality nature of the Croda business? Could others follow?

Western Europe

- Some investments for in-house majors are being made for EO/Ethoxylation

United States

- Plenty of activity on “shale gas” ethane crackers – will this continue? Many could invest in MEG and EO derivatives such as Sasol, Oxiteno and several others

Regulatory/ Consumer Pressures

Consumer preferences for “greener” alternatives bio based transparency, RSPO, sustainability issues may cause a rethink to portfolio management for EO suppliers

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