

Maximising Crude Oil to Chemicals Conversion

Trends, challenges and opportunities

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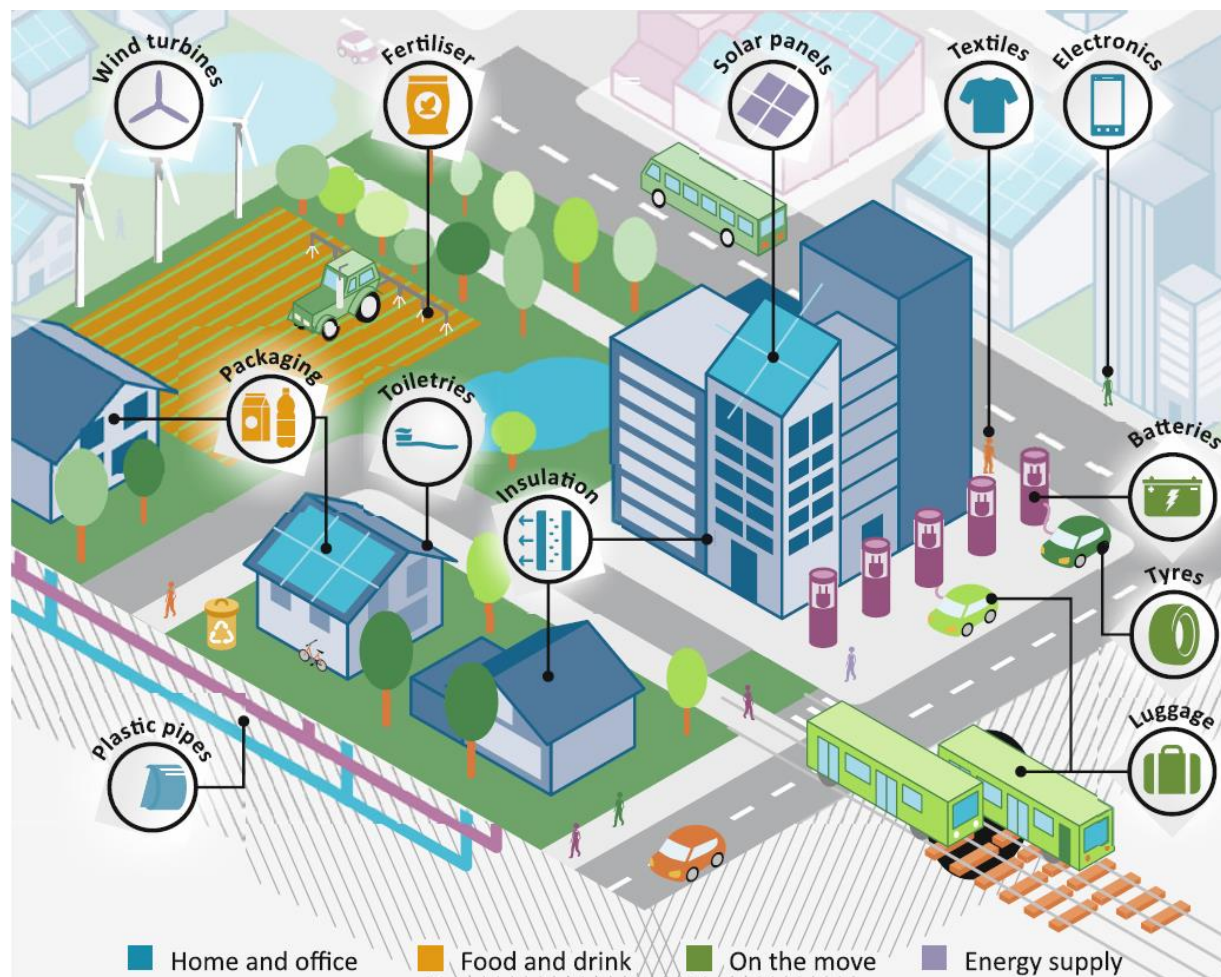
Petrochemicals losses and BI Volatility Clause

Petrochemicals

- // Synthetic materials derived from oil and natural gas
 - // 90% of chemicals are produced from oil and gas (10% from coal and biomass)
 - // In a petrochemical plant oil and gas are converted into the building blocks for the production of chemicals such as plastics

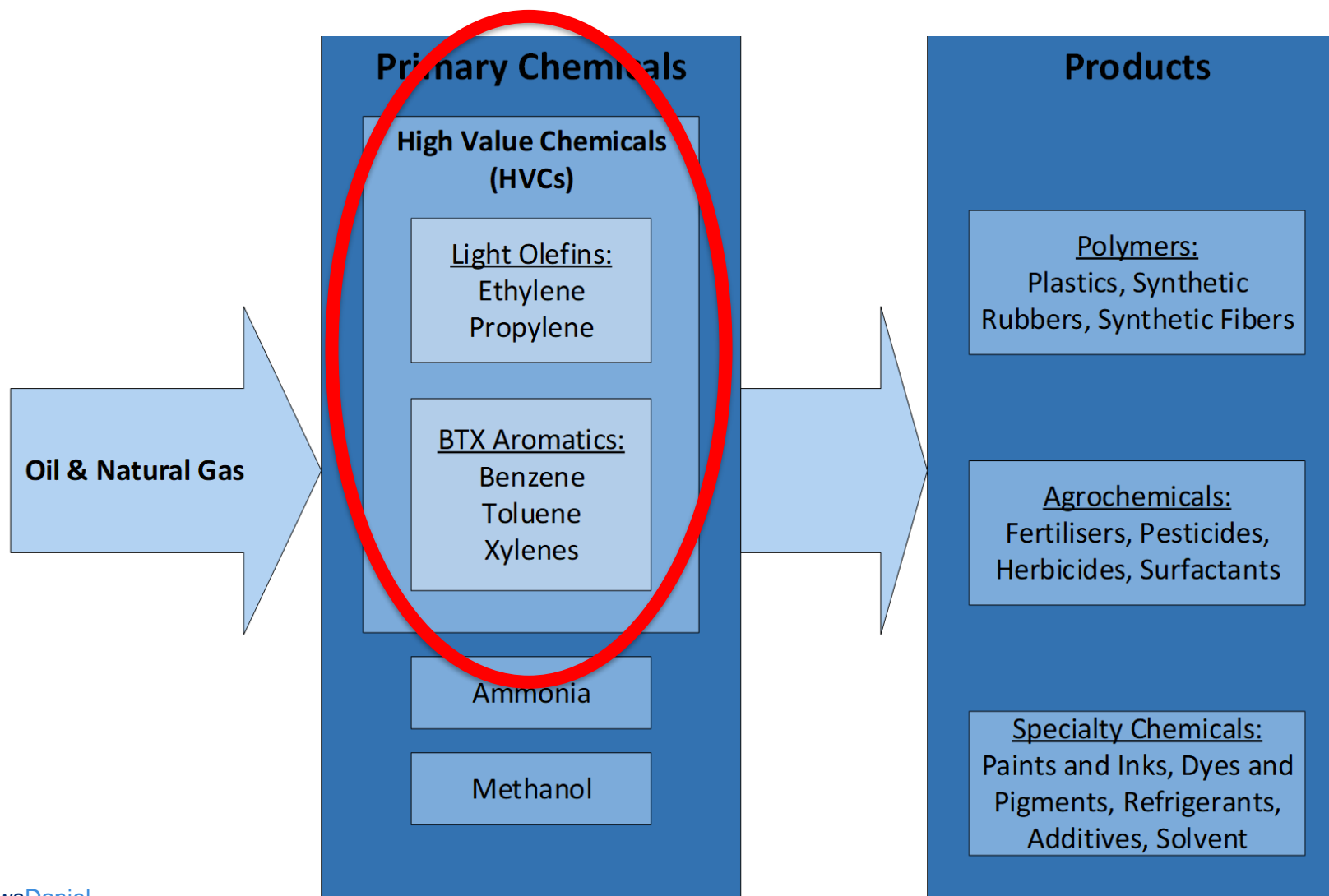


Petrochemicals



Source: IEA

Petrochemicals Value Chain



Petrochemicals Value Chain – Examples

// Ethylene

- // Plastics (e.g., PE for plastic bags and food containers, PET for plastic bottles), antifreeze, detergents

// Propylene

- // Plastics (e.g. PP for car parts), carpets, textile (acrylic fibres), epoxy glues

// Benzene

- // Adhesives, nylon, explosives, dyes

// Toluene

- // Gasoline blending, solvents, plastics (e.g. polyurethane for sports equipment)

// Paraxylene

- // Textiles (polyester), plastics (e.g., PVC for electrical wires' insulation)

// Methanol

- // Pressed-wood products (particleboard, plywood, and fibreboard), glues, gasoline blending (MTBE), paints

// Ammonia

- // Fertilisers, fibres (nylon and acrylic), explosives

Importance of Petrochemicals

// Petrochemical's importance is poised to grow significantly due to:

// Contraction of oil's demand and structural change of demand

// Rapid increase in demand for petrochemicals

Net Zero

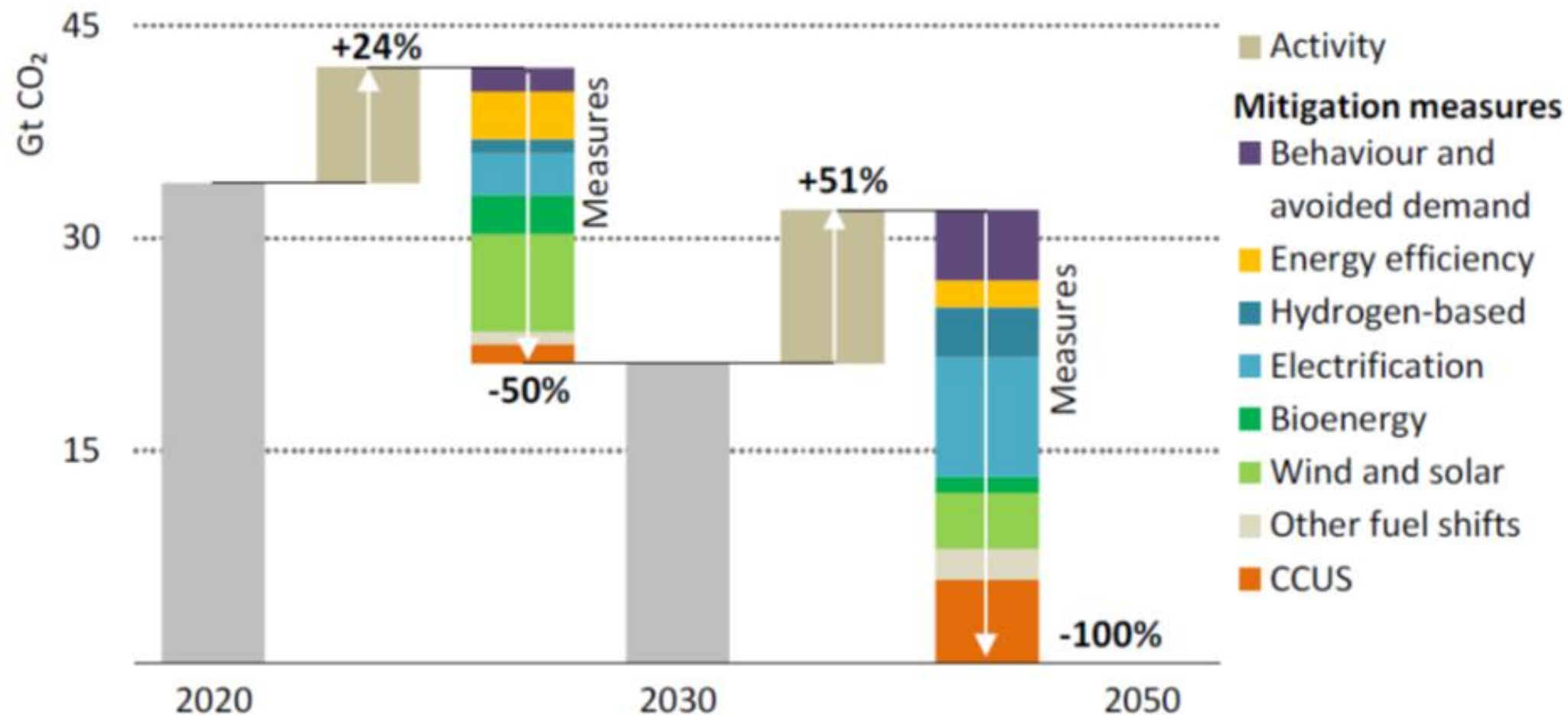
// The Paris Agreement (2016):

- // Limit the rise in mean global temperature to 1.5°C by reducing GHG emissions
- // To meet this target by 2100, GHG emissions will need to drop by 50% by 2030 and reach “Net Zero” by 2050

// Net Zero: **GHG Produced + GHG Removed = 0**

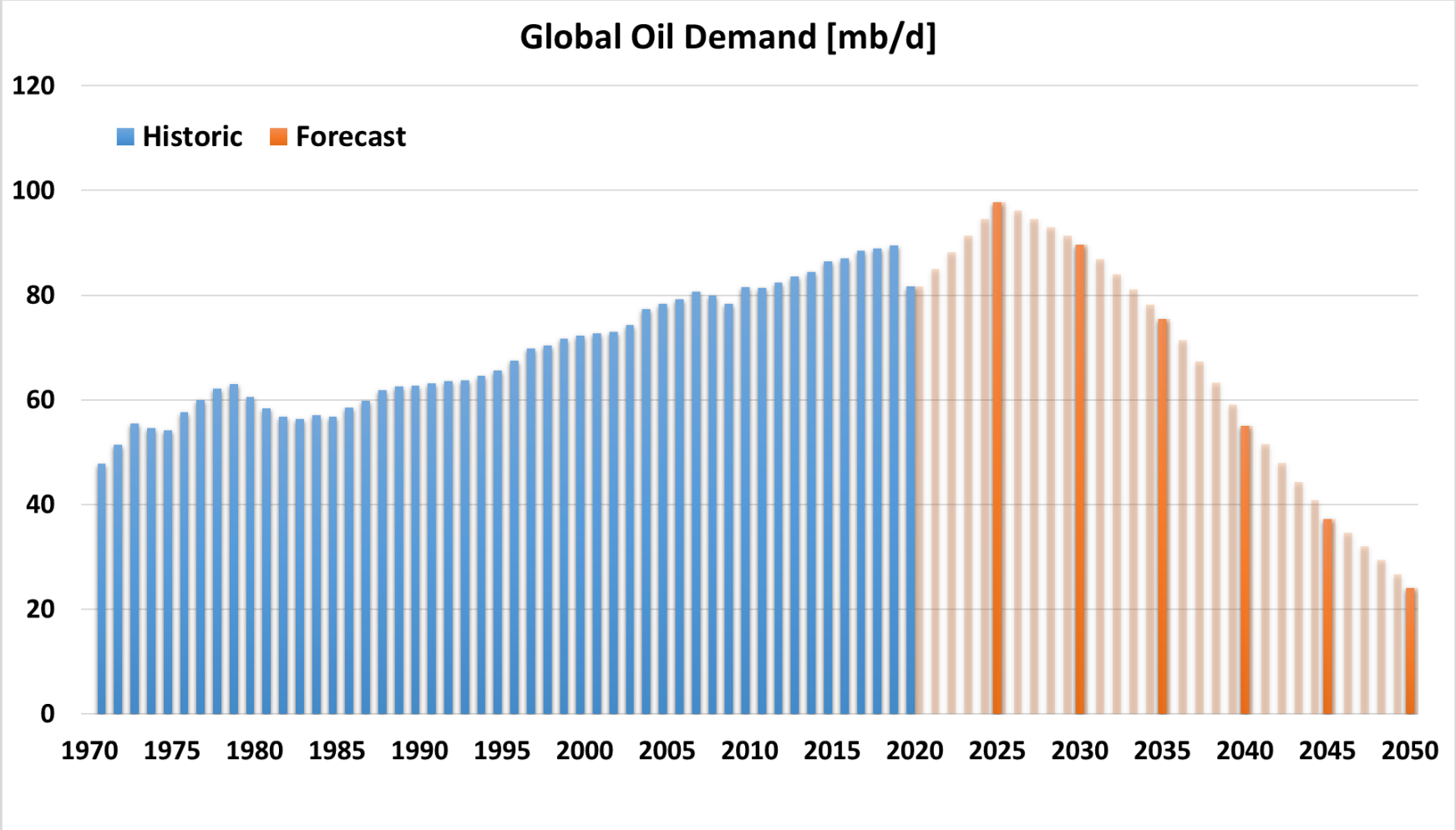
- // Emission reduction
- // Carbon offset

Achieving Net Zero by 2050

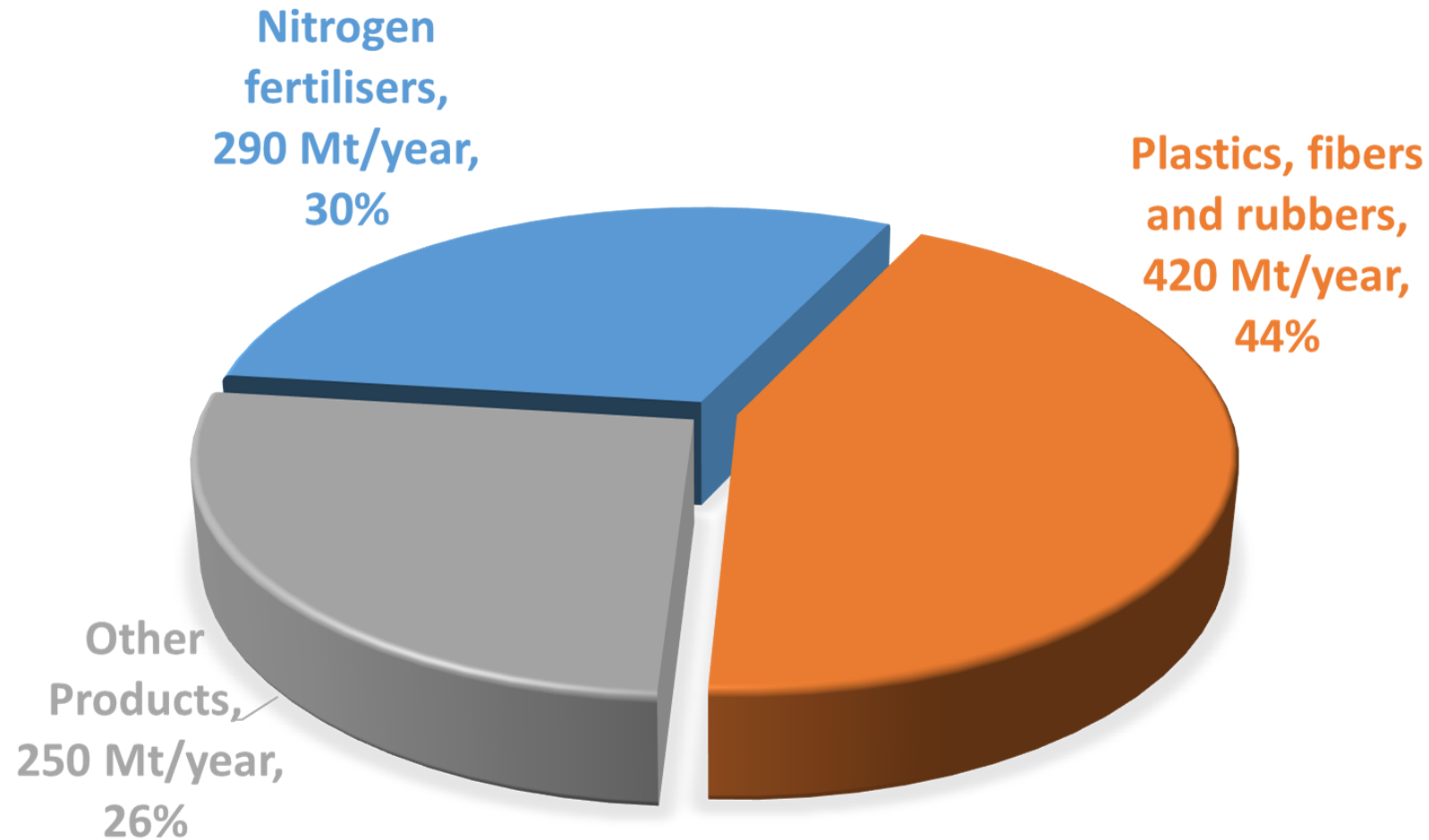


Source: IEA

Achieving Net Zero by 2050

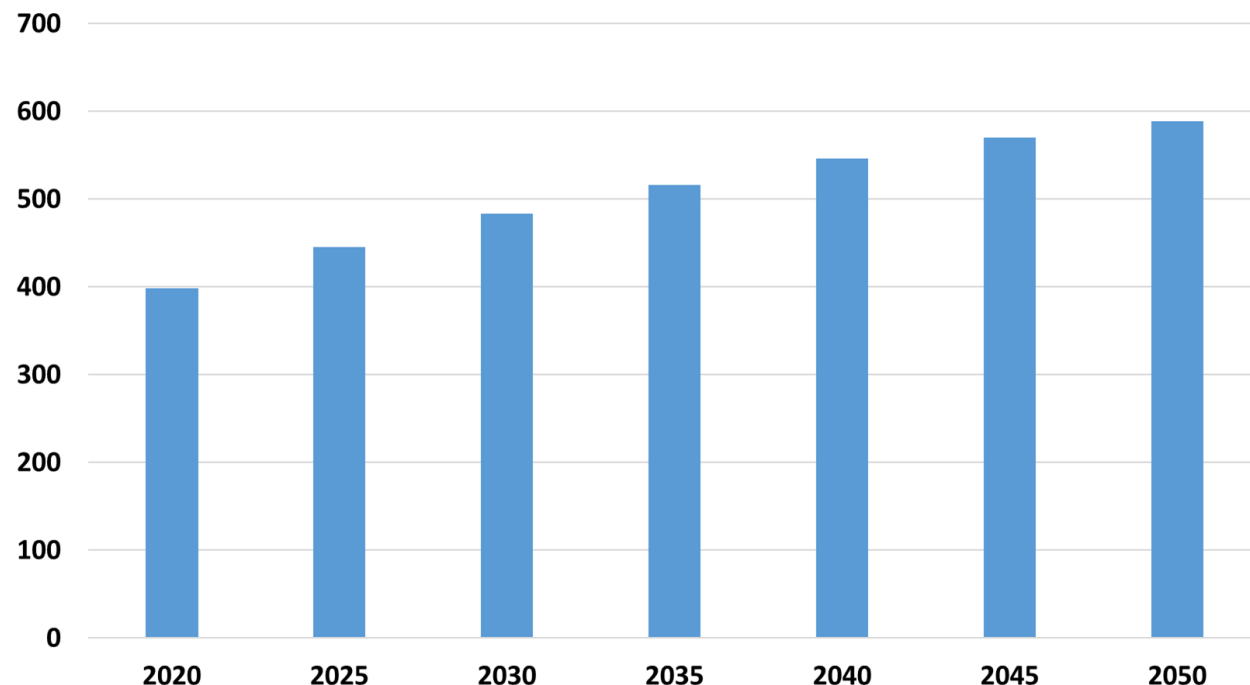


Petrochemicals Industry Trends



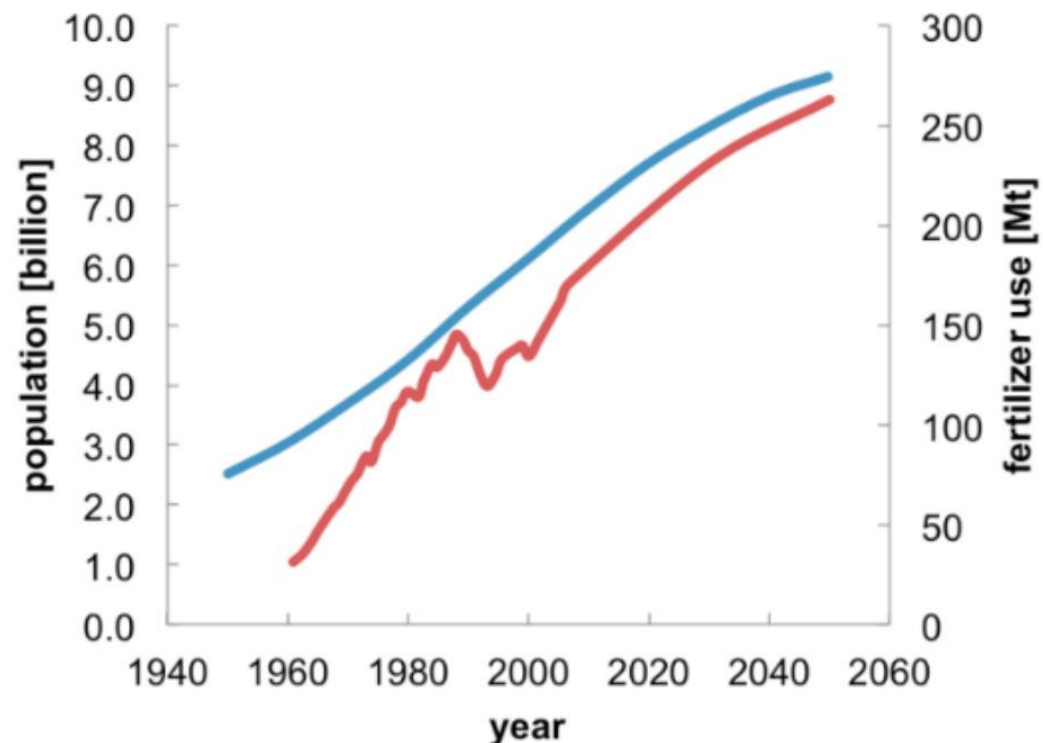
Petrochemicals Industry Trends

Global production of thermoplastics
(million metric tons)



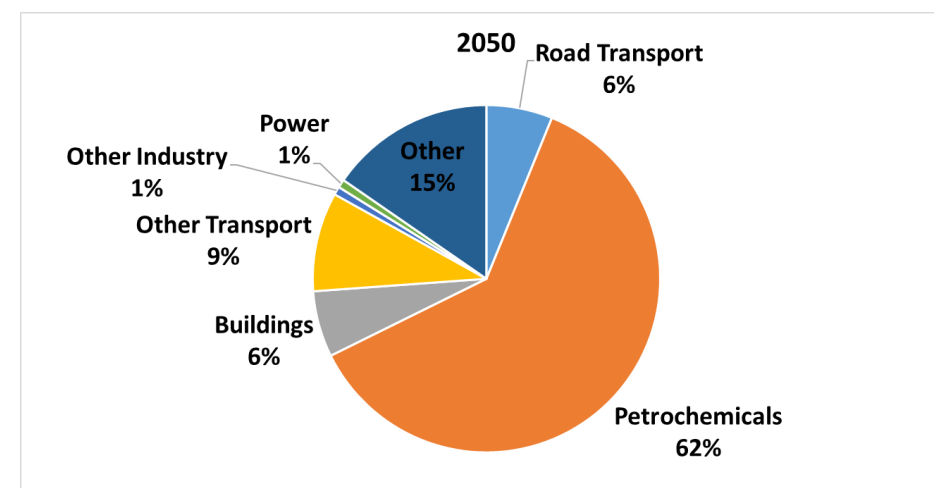
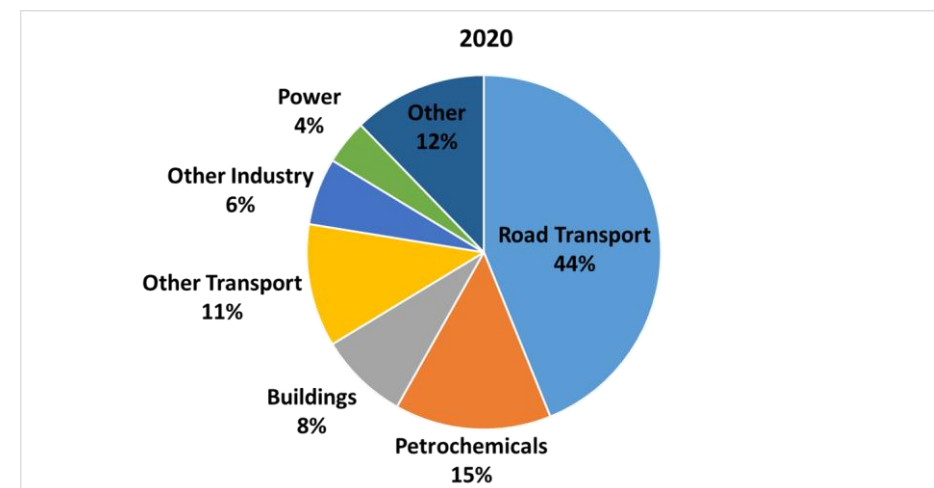
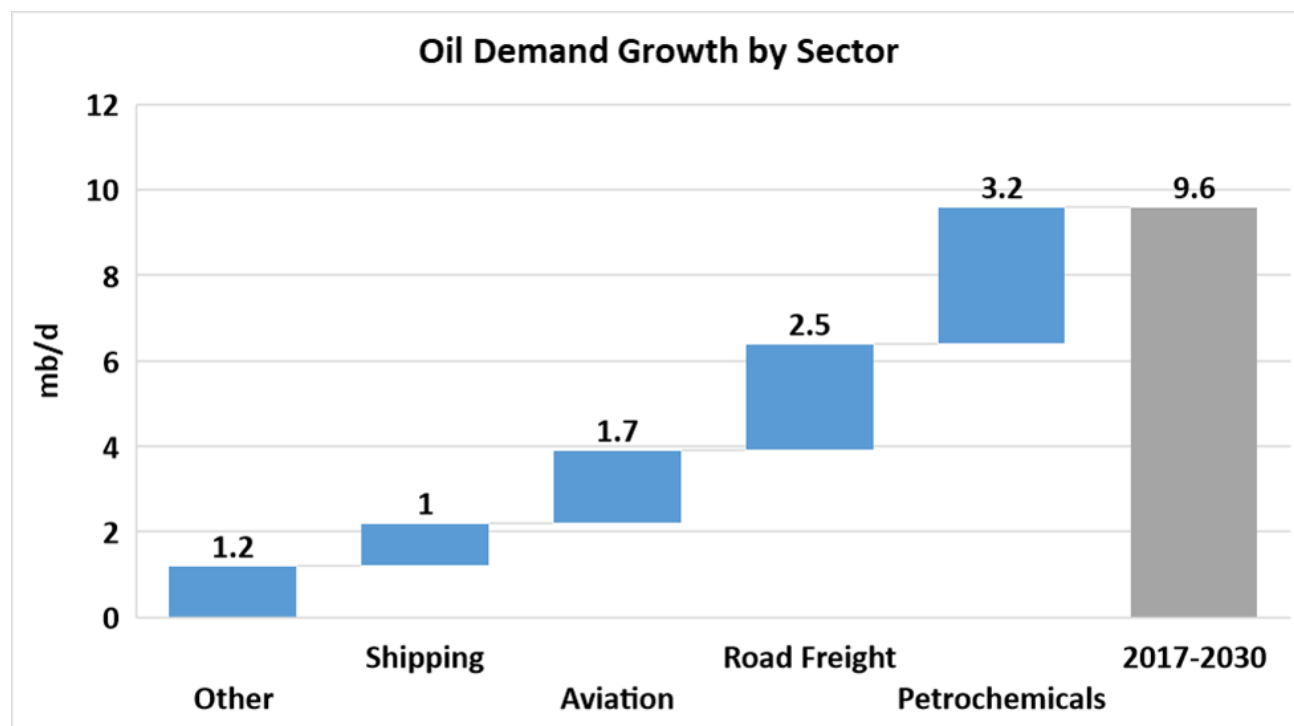
Source: IEA

population fertilizer use

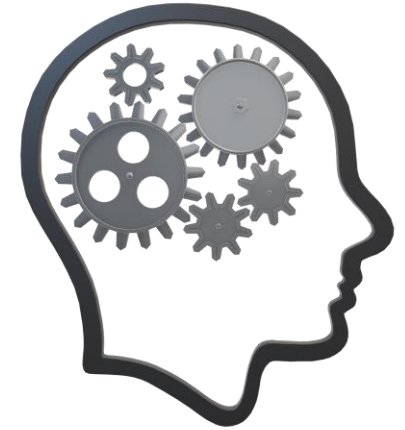


Source: European Innovation Partnership for Agricultural Productivity and Sustainability

Importance of Petrochemicals



Oil Companies Challenges

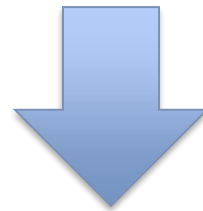


// Shrinking global oil demand

// Refinery utilisation drop from 85% to circa 70%

// Shift in products mix: less gasoline, more jet fuel and petrochemicals

// Refinery margin drop



// Greater integration of refineries and petrochemical plants

Refinery & Petrochemicals Integration

// Increased flexibility and resilience

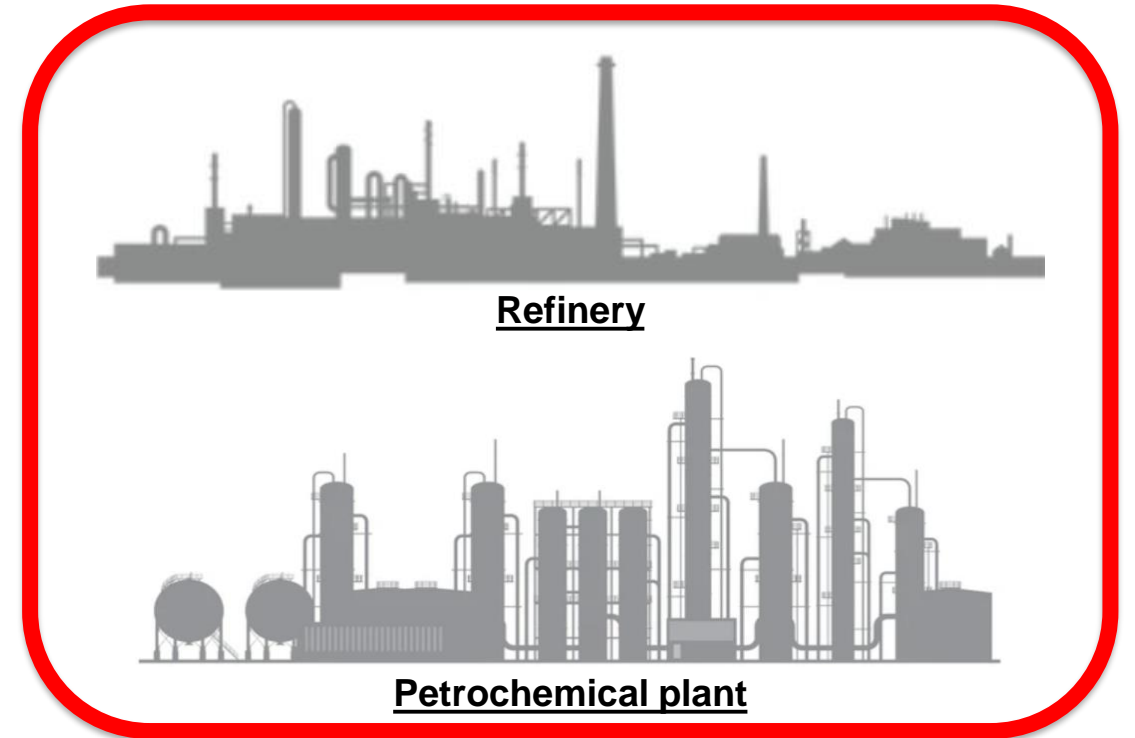
// Improved economics

// Better margins

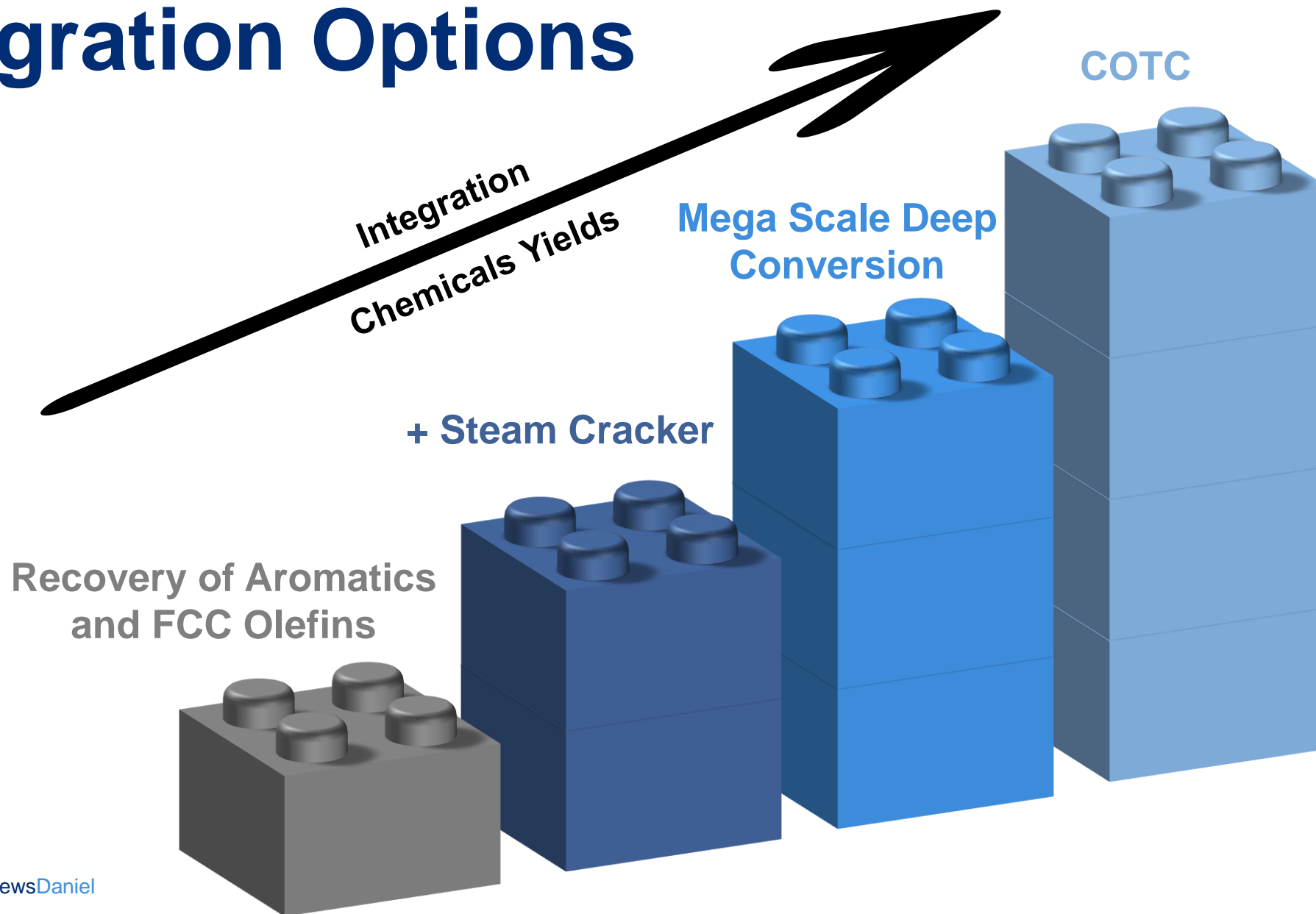
// Higher IRRs

// Capital intensive projects

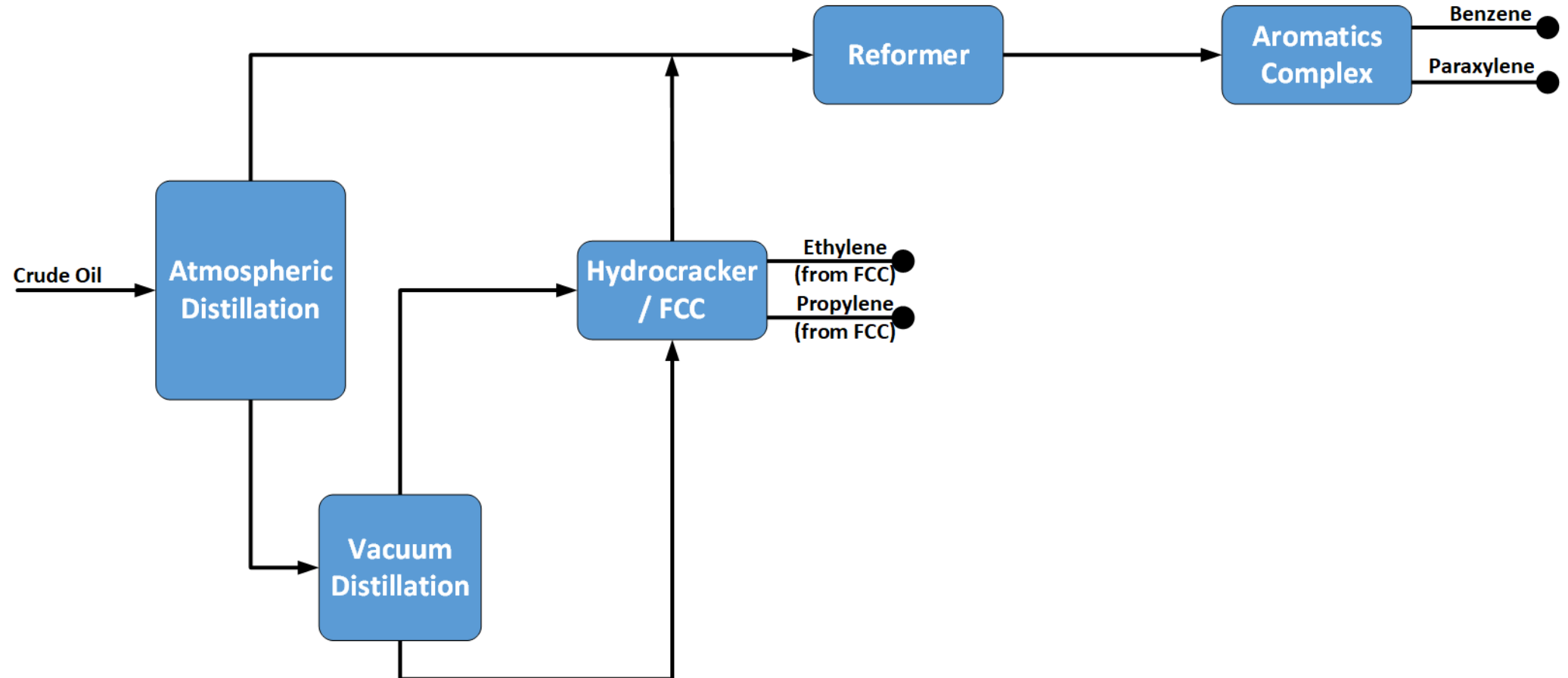
// Integration also increases the complexity of an operation.



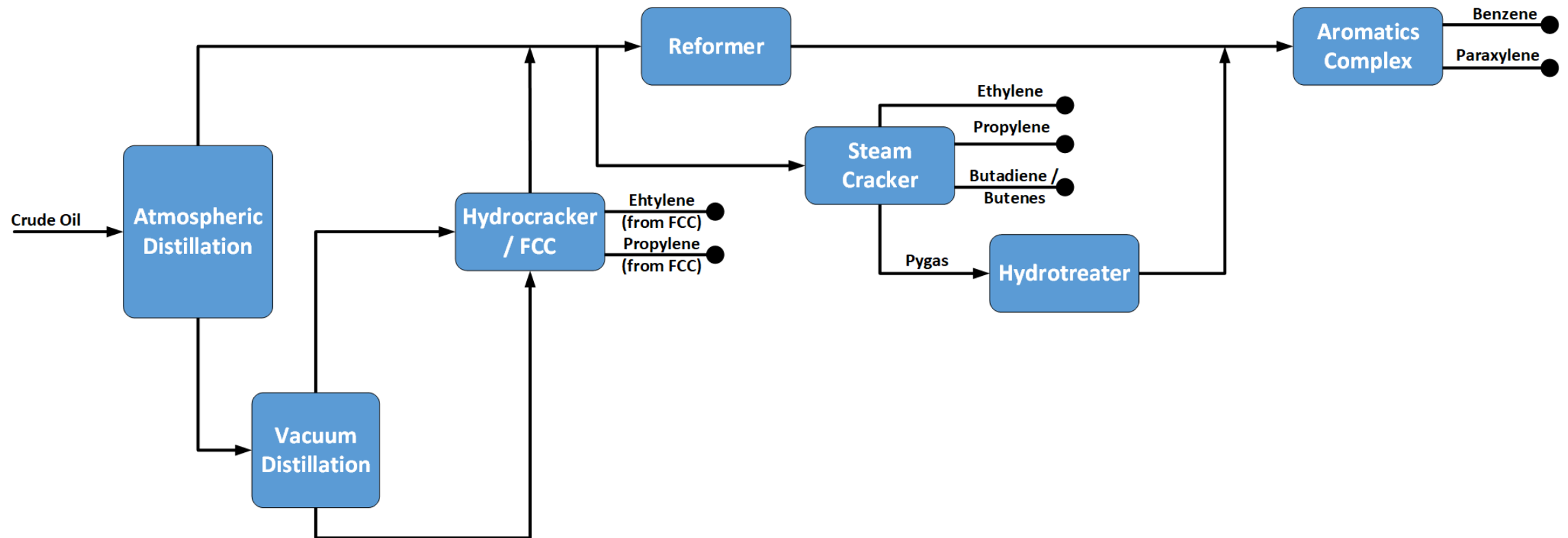
Integration Options



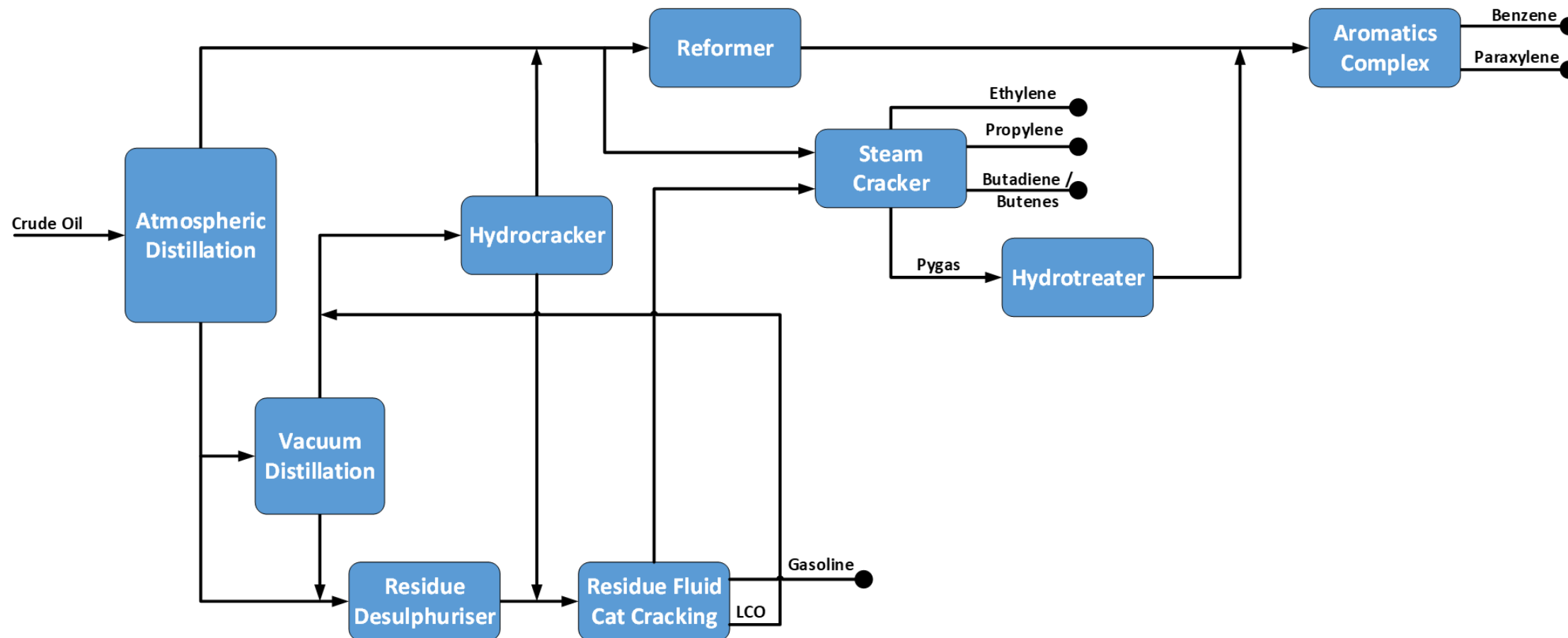
Recovery of Aromatics and FCC Olefins



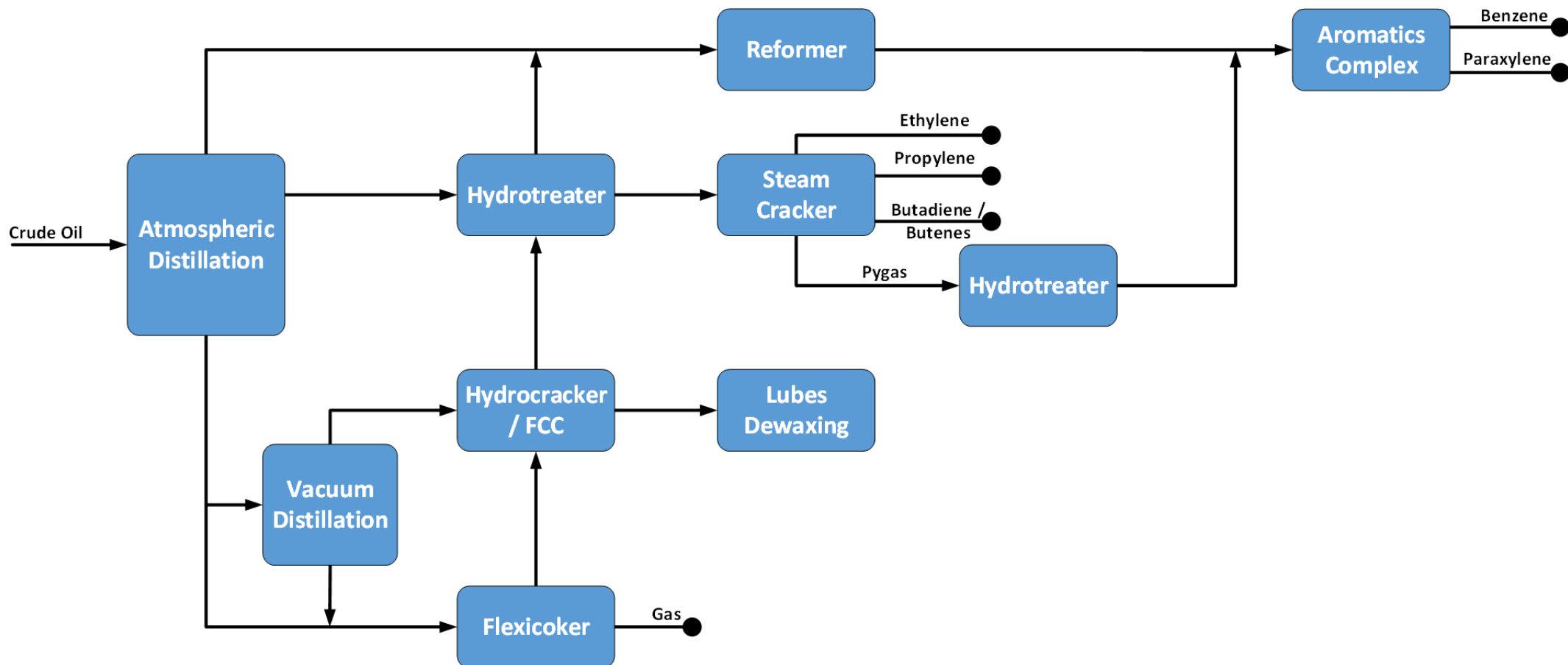
Steam Cracker Addition



Mega Scale Deep Conversion



Exxon Flexicoker



COTC

- // Allows the direct conversion of crude to high-value chemicals

- // Maximises chemicals yield

 - // Traditional refinery: circa 10%

 - // COTC: >40% and up to 70-80%

- // Routes to COTC

 - // Reconfiguring existing refineries

 - // Building grassroot highly integrated plants

COTC – New Technologies

// ExxonMobil Light Crude Steam Cracking



// 1 MTPA Unit commissioned in 2014 at the Singapore Refinery

// Chemicals yield: 75%

// Aramco / CB&I / Lummus Thermal Crude to Chemicals (TC2C™)



// Based on Advanced Separation Devices and Residue Hydroprocessing

// Chemicals yield: >70%

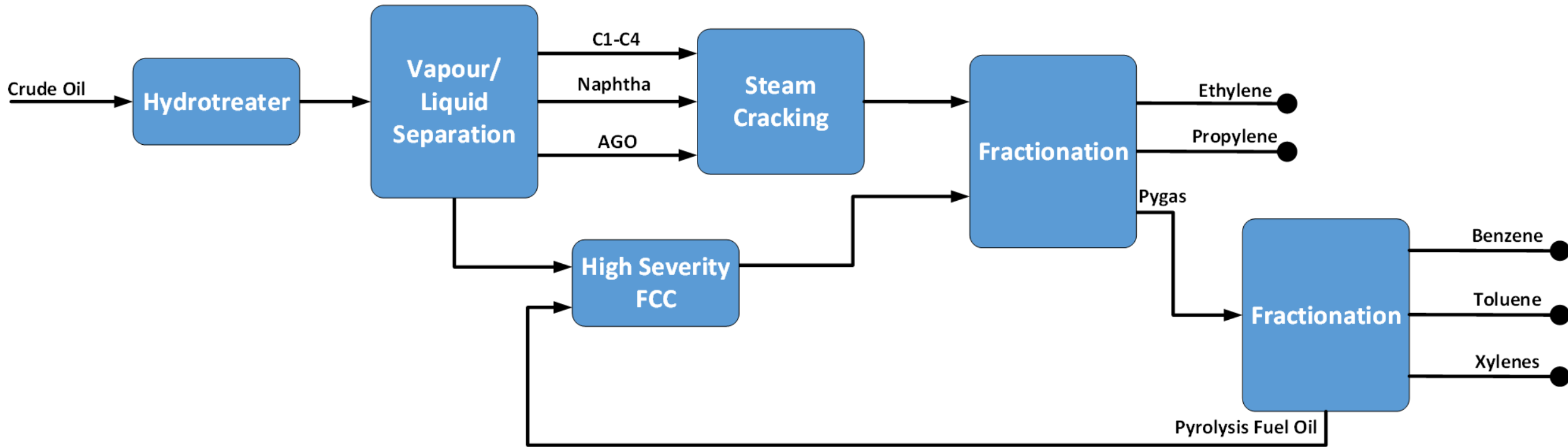
// Reliance Multi-zone Catalytic Cracking



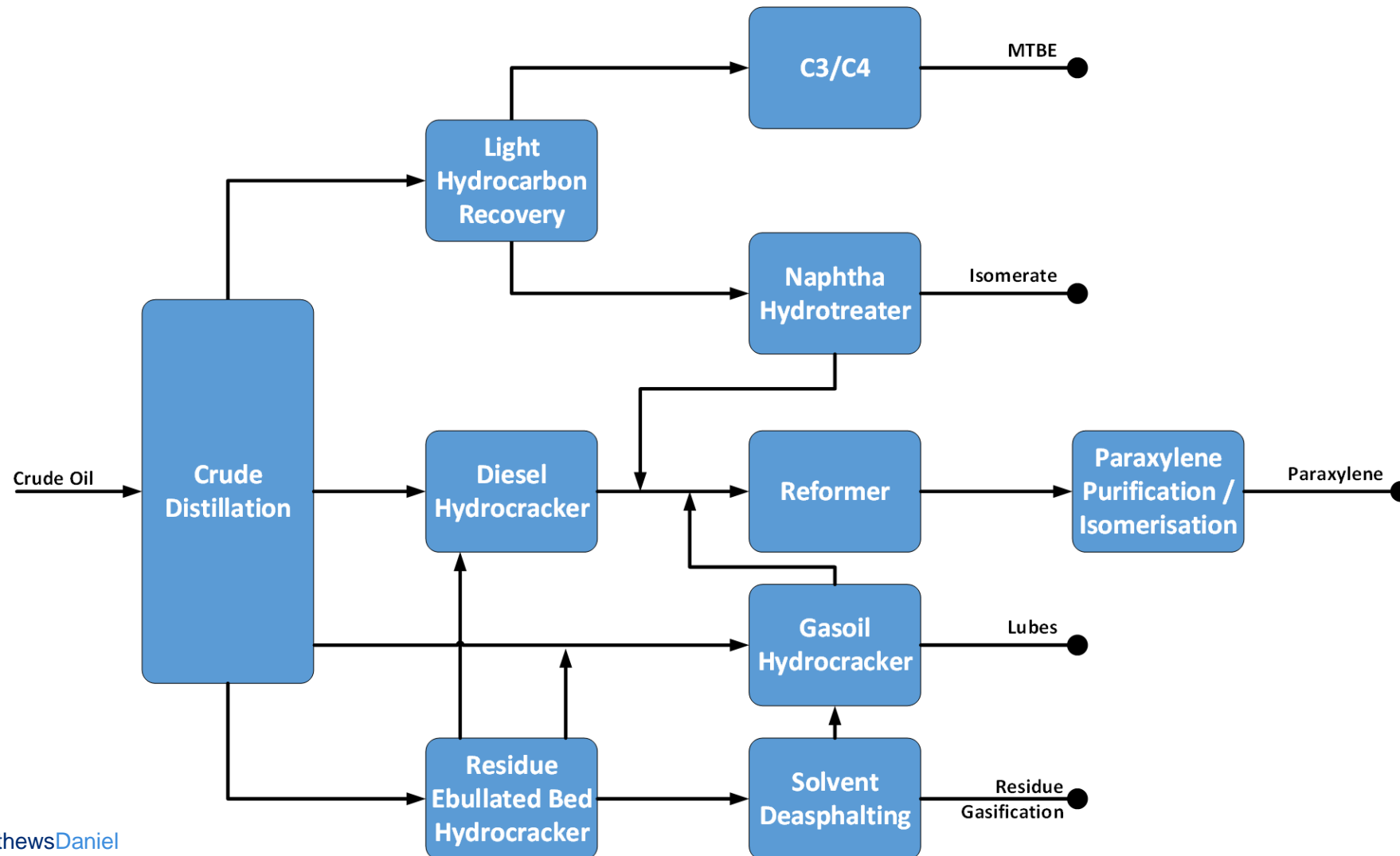
// Combines High Severity FCC, Steam cracking and Methanol to Olefins

// Chemicals yield >70%

COTC – Aramco/Sabtic JV



COTC – Hengli Petrochemical



COTC – Locations

// Where it makes sense

// Cost of raw material

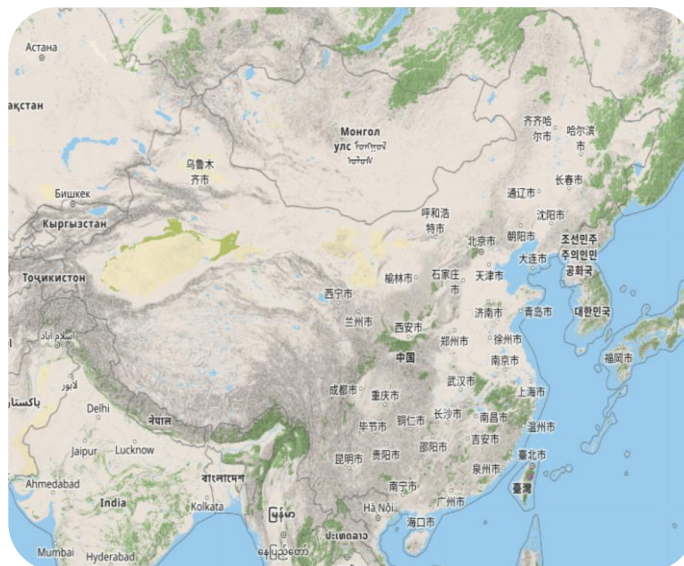
// Products market proximity

// Economies of scale

// Different drivers:

// Middle East

// China



Refinery

Integration

Petrochemical

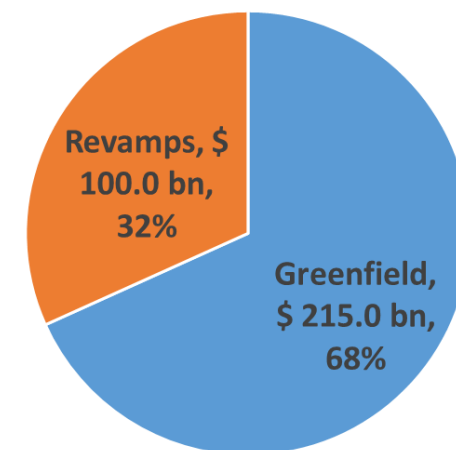
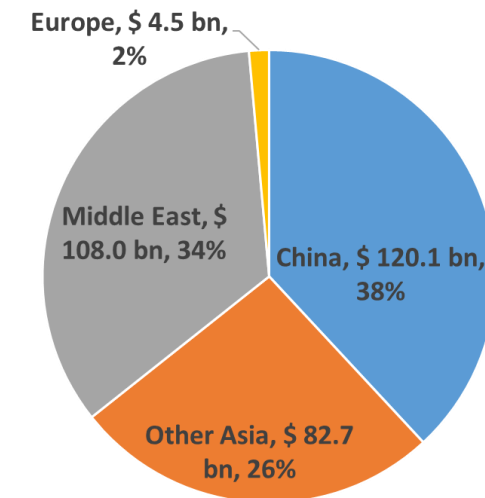
Refinery

Integration

Petrochemical

COTC – Project Pipeline (2019)

Company	Location	Cost (\$ bn)	Type	Start-up
Zhejiang Petroleum and Chemical	Zhoushan, China	26	Greenfield	2019 (Phase 1)
Hengli Petrochemical	Changxin Island, China	11	Greenfield	2019
Shenghong Petrochemical	Lianyungang, China	11.84	Greenfield	2019
Ningbo Zhongjin Petrochemical	Ningbo, China	5 (est)	Revamp	2018
Saudi Aramco/NORINCO/Panjun Sincen	Liaoning Province, China	10+	Greenfield	2024
SABIC/Fuhaichuang Petrochemical	Zhangzhou, China	NA	Greenfield	N/A
SINOPEC/SABIC (Tianjin Petrochemical)	Tianjin, China	45 combined (est)	Revamp	Operating, pre-2017
PetroChina	Dalian, China		Revamp	Operating, pre-2017
PetroChina	Yunnan, China		Revamp	Operating, pre-2017
CNOOC	Huizhou, China		Revamp	Operating, pre-2017
SINOPEC	Lianyungang, China	2.8	Greenfield	N/A
SINOPEC	Caofeidian, China	4.2	Greenfield	N/A
SINOPEC	Gulei, China	4.26	Greenfield	2020
Hengyi Group	Pulau Muara Besar, Brunei	20	Greenfield	2020
Saudi Aramco/ADNOC/India Consortium	Raigad, India	44	Greenfield	2025
Petronas/Saudi Aramco (RAPID)	Pengerang, Malaysia	2.7	Greenfield	2019
ExxonMobil (Singapore Chemical Plant)	Jurong Island, Singapore	<1	Revamp	2023
Pertamina/Rosneft	Tuban, East Java, Indonesia	15	Greenfield	2025
ADNOC	Al Ruwais, UAE	45	Revamp	2025
Saudi Aramco/SABIC	Yanbu, Saudi Arabia	30	Greenfield	2025
Saudi Aramco/Total	Jubail, Saudi Arabia	5	Greenfield	2024
KNPC/KIPIC (Al-Zour Refinery)	Al Ahmadi, Kuwait	13	Greenfield	2019
Oman Oil Company/Kuwait Petroleum International (Duqm Refinery)	Oman	15	Greenfield	N/A
MOL Group	Hungary, Croatia	45	Revamp	2030



The background of the slide is a dark blue field filled with various chemical structures in a lighter blue color. These structures include organic molecules with rings, chains, and functional groups, as well as inorganic species like a nitrate ion (NO3-) and a sodium ion (Na+). The structures are scattered across the background, creating a scientific and technical atmosphere.

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