The Refinery of the Future

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Honeywell UOP

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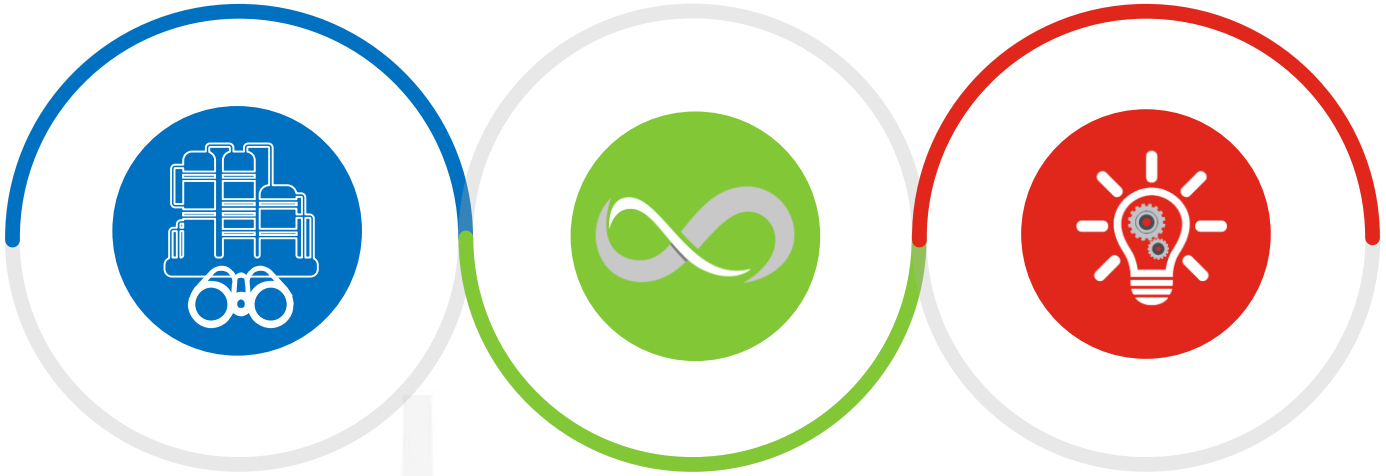
Agenda



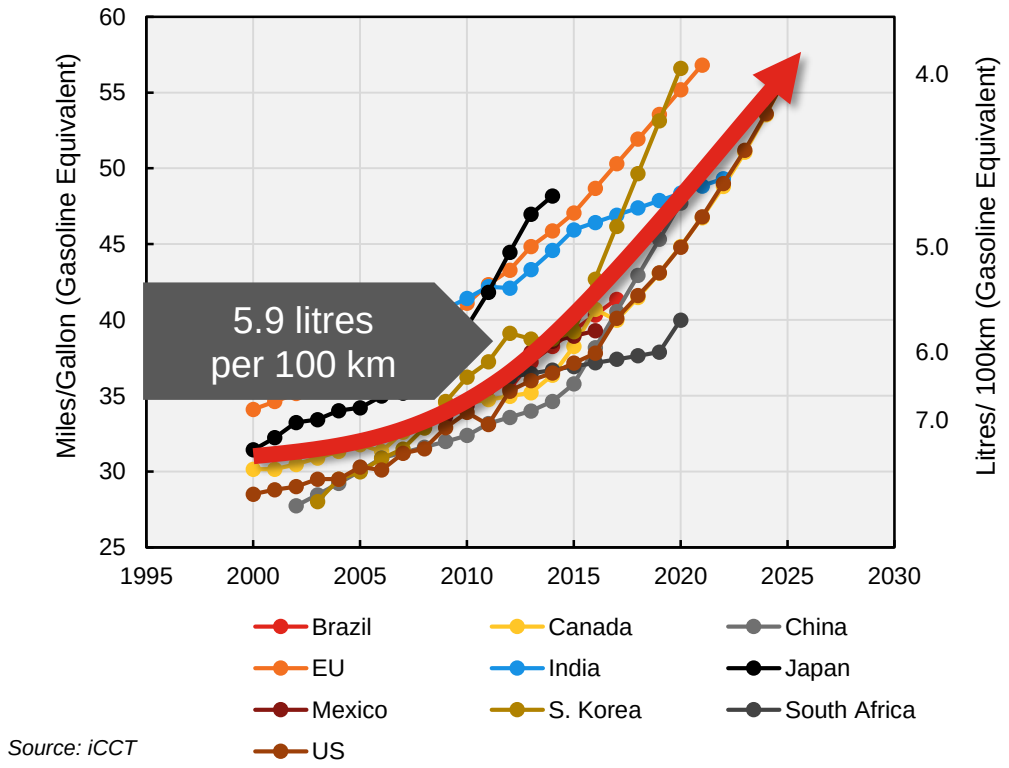
Outlook for Refining

Opportunities and Solutions

The Refinery of the Future

Fuel Economy and Hydrocarbon Displacement

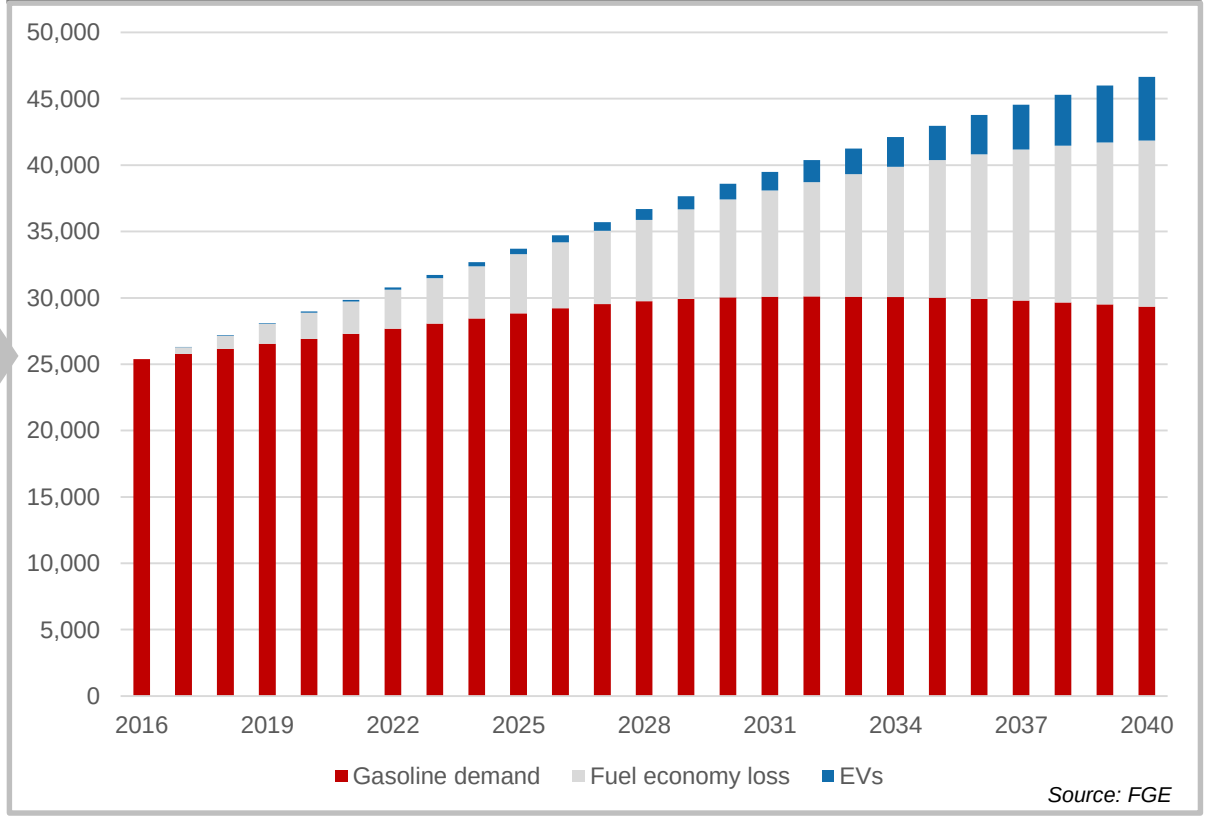
Global Fuel Economy Targets



Source: iCCT

→ Countries representing 70% of global gasoline demand will be at or below 5.9 litres per 100 km by 2020

Global Gasoline Displacement



Source: FGE

→ Electric vehicles will displace 52 – 86 MTPA of gasoline by 2035
→ 500 MTPA of gasoline demand displaced by fuel economy by 2040

Fuel Efficiency and EVs Reduce Fuel Demand after the Mid-2020s

Dangote refinery will transform, diversify Nigeria's economy

By Udeme Akpan

The $12 billion Dangote refinery will transform and diversify Nigeria's economy when completed in 2019.

Algeria's Sonatrach To Produce Cleaner-Burning Transportation Fuels

AFP -- Sonatrach will use technologies from Honeywell UOP to expand the Skikda Refinery on the eastern Mediterranean coast of Algeria. The new technologies will enable Sonatrach to meet growing domestic demand

...to Expand ...Operations

...ounced plans today ...ill use technologies ...kda Refinery on the ...e new technologies ...omestic demand for ...el that meets Euro V ...leaner-burning fuels.

Orlen Liet... Refinery C...

Sonia Partovic

Polish-Lithuanian ... to expand its refin... technologies from ... Ref... new... dor... me...

ANRPC Refinery Project Nears Completion

Alexandria National Refining and Petrochemicals Company (ANRPC) has finished 97% of the refinery

Jizzakh Petroleum To Build New Refinery In Uzbekistan

Jizzakh Petroleum will build a new refinery capable of processing 5 million tons per year of crude oil to produce clean-burning gasoline, diesel and jet fuel. The refinery is being built in the Jizzakh region of F...

JPRC Signs Agreement with UOP to Expand Jordanian Refinery

(Jordan - May 8) The Jordan Petroleum Refinery Company (JPRC) will undertake a $1.6 billion expansion of a 100,000 bpd refinery in Zarqa, Jordan to produce cleaner-burning fuels.

Petron to Expand Clean Fuels Production at Limay Refinery

July 24 -- Petron Corporation will expand and upgrade its Limay, Bataan refinery in The Philippines. When completed, the complex will produce

IRPC to Build Aromatics Complex in Thailand

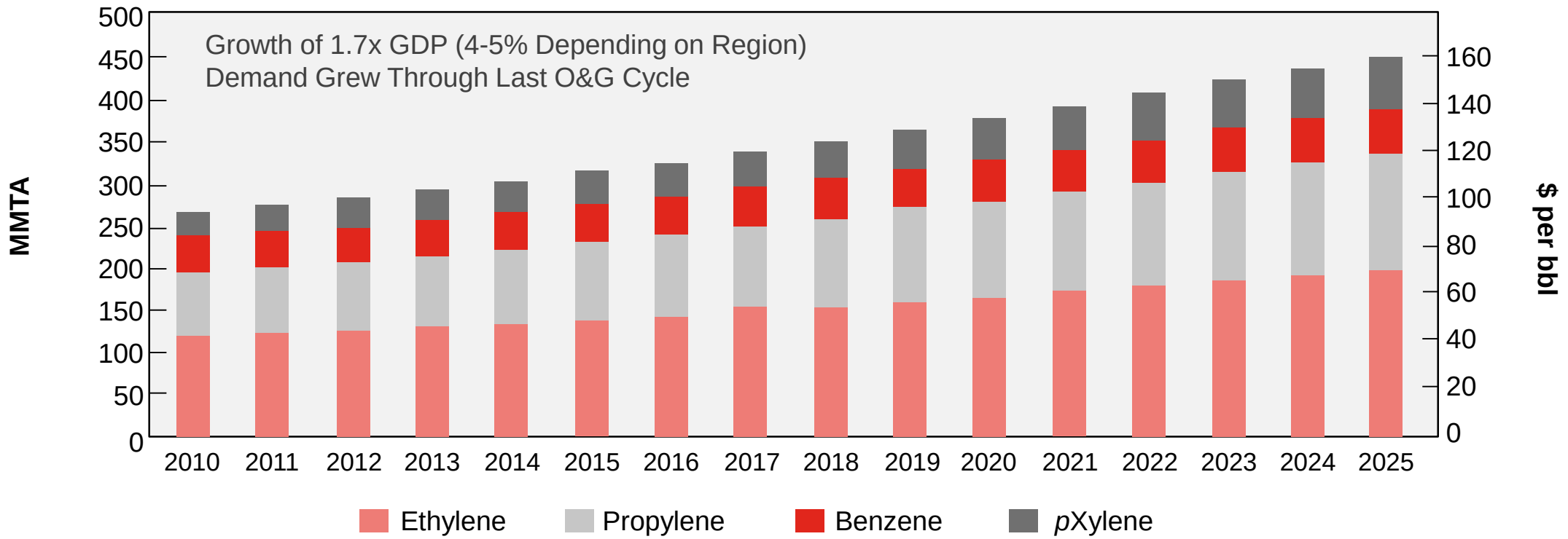
May 24 -- IRPC will build a new aromatics complex and CCR Platforming unit at its refinery complex in Rayong, Thailand.

Capacity build in developing regions challenges export opportunities

Petrochemicals Show Consistently Strong Growth

Global Petrochemical Mix

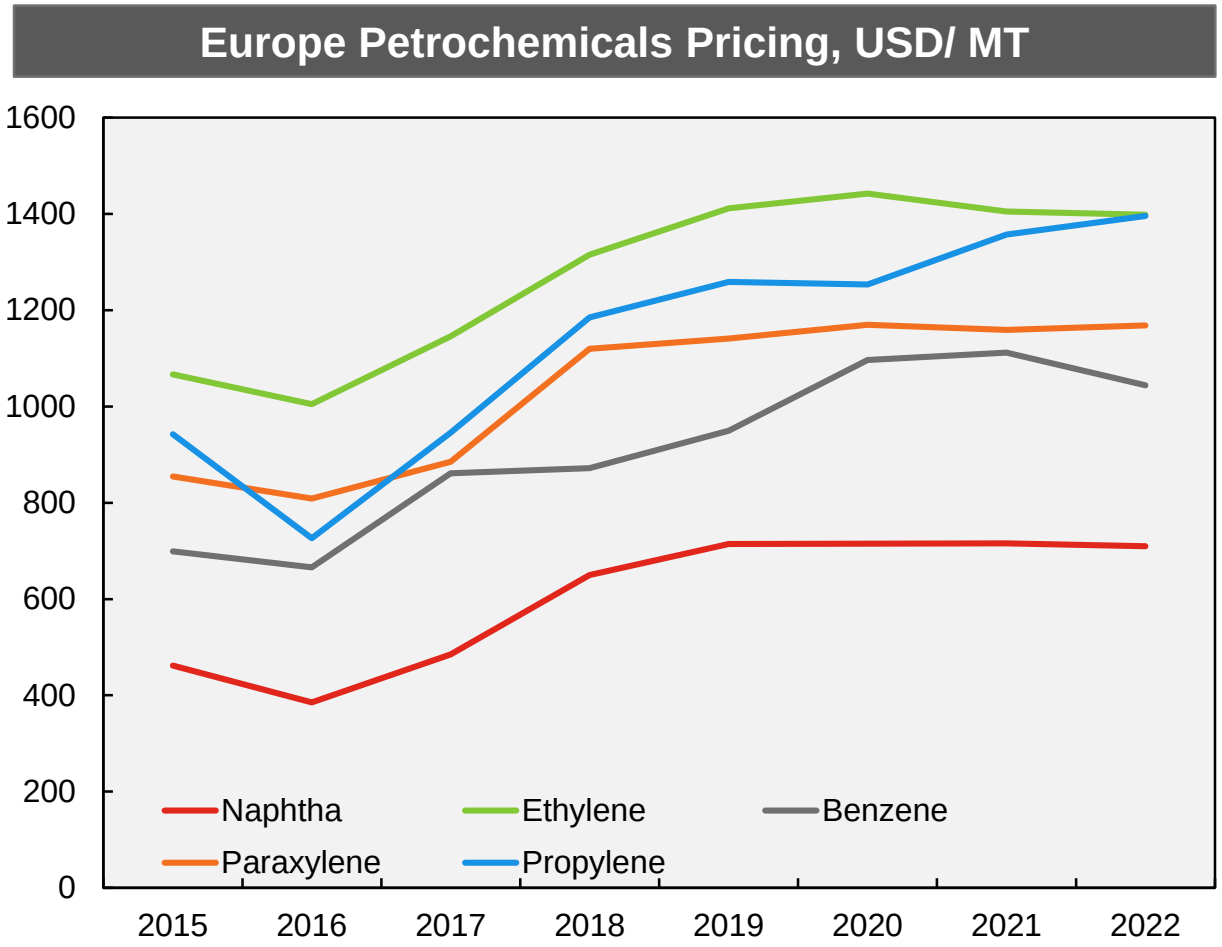
Petrochemical Demand Remains Robust Through the Oil & Gas Cycle



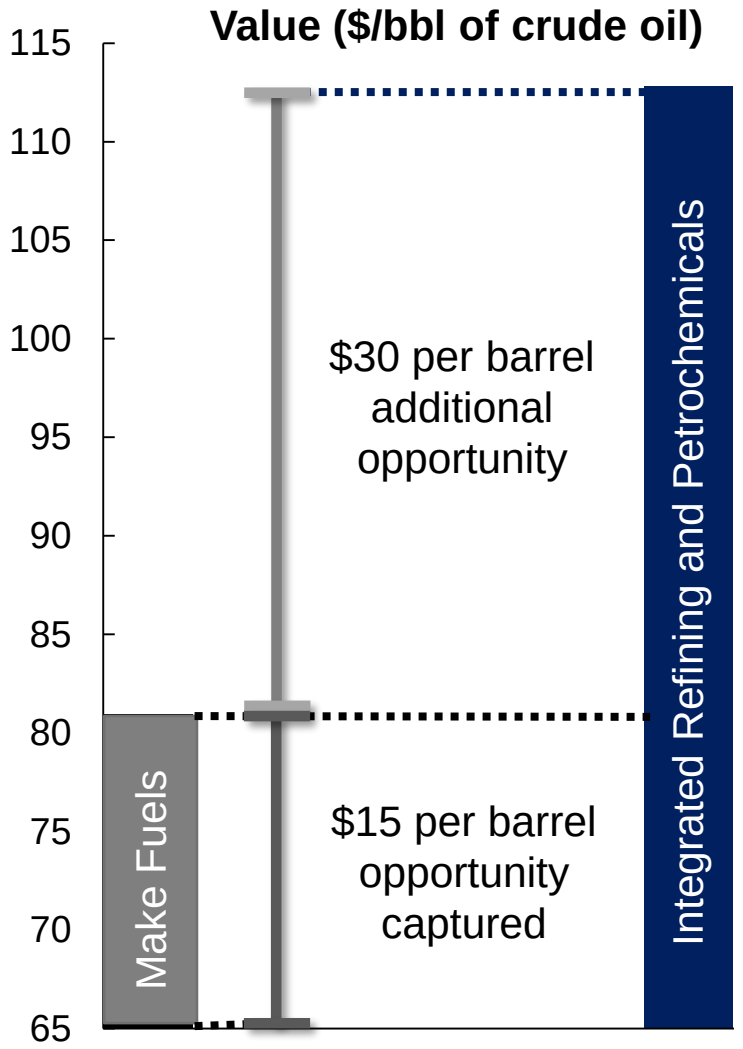
Source: IHS Markit, UOP Analysis

Consumer growth drives consistently strong returns in Petrochemicals

Petrochemicals Value Add



Source: IHS

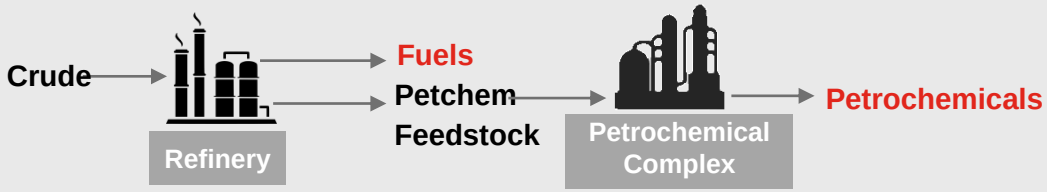
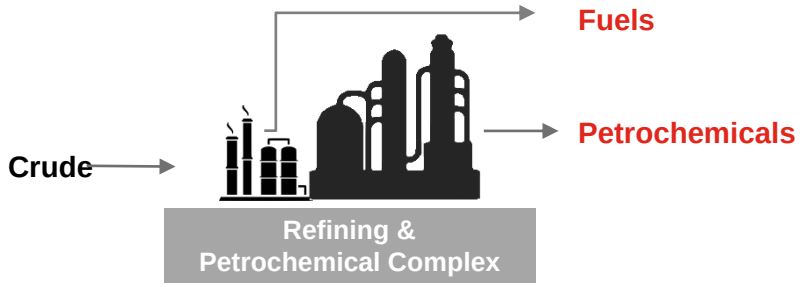
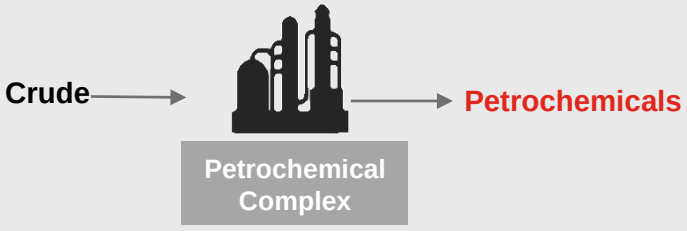


Source: UOP Analysis

Petrochemicals Integration Offers 200% More Value

The Refinery of the Future

Industry Transformation

	Crude Processing: Fuels to Petrochemicals	Customer Needs
Today		• Maximum transportation fuels (gasoline, diesel, and jet) • Opportunistic petrochemicals
Developing		• More stringent fuel specifications • Less diesel, more jet fuel • Product flexibility to meet market needs • More petrochemicals: ideally at 75% olefins, 25% aromatics • Lower environmental footprint • Higher capital efficiency
Long Term		• Zero-fuels • Direct to petrochemicals through alternative routes • Lower environmental footprint • High capital efficiency

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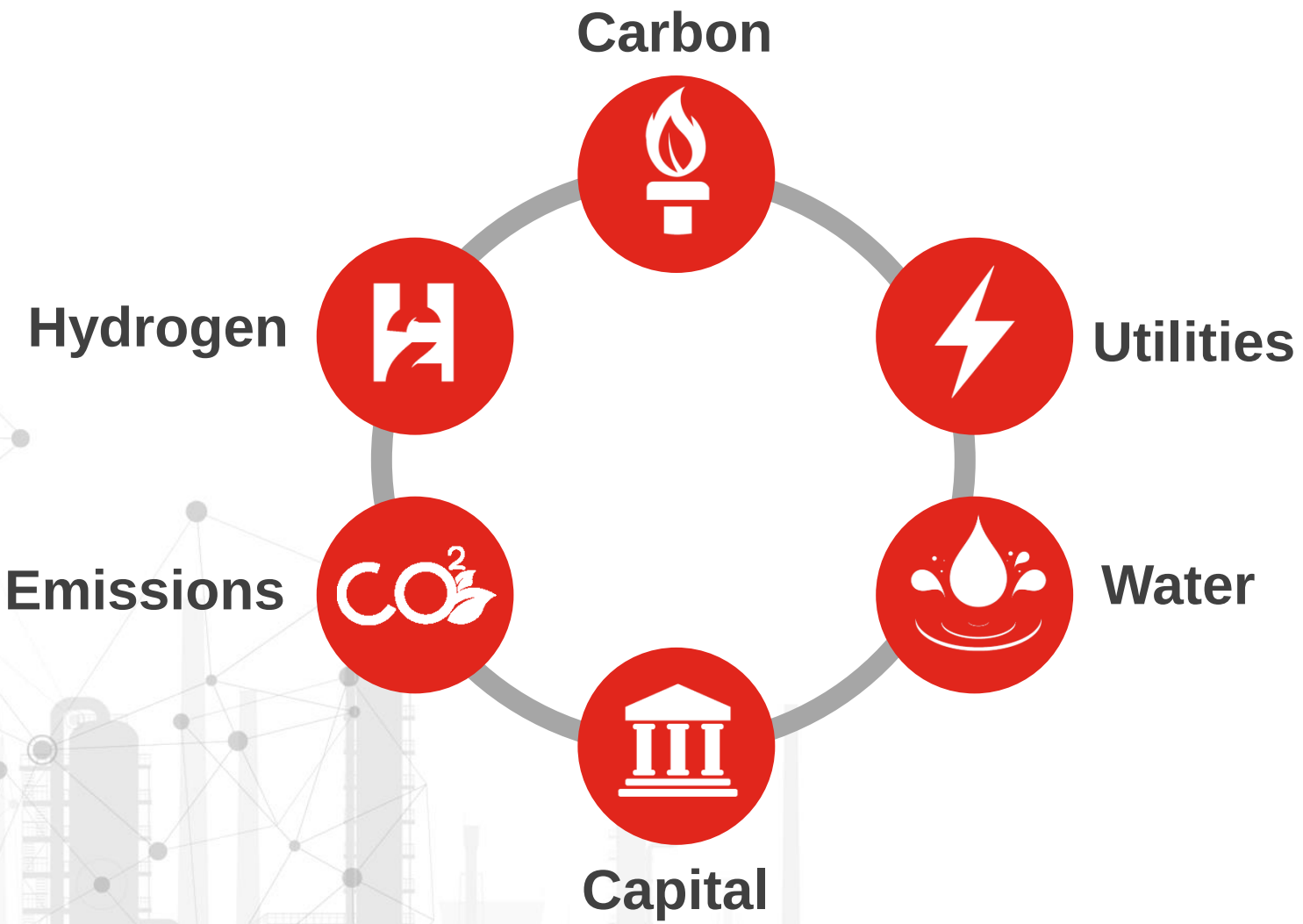
6-Efficiency Metrics to an Optimized Configuration



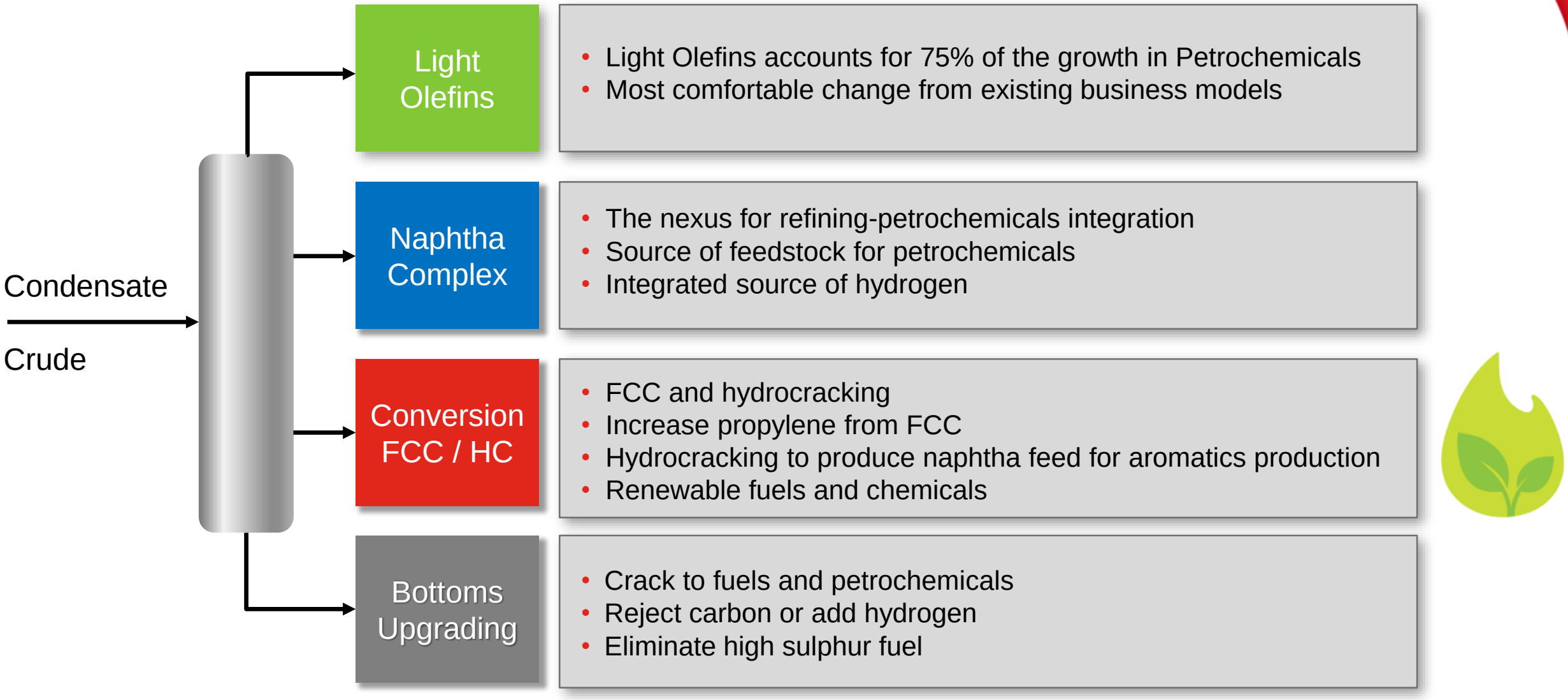
Molecule Management

What Is Molecule Management?

Imagine the ability to **sort and direct** each and every molecule within a barrel of oil to the **right processing unit**, operated at the **optimum conditions**, and containing the **best possible catalyst** or adsorbent. And to do this as feedstocks and **economic conditions continually change**.

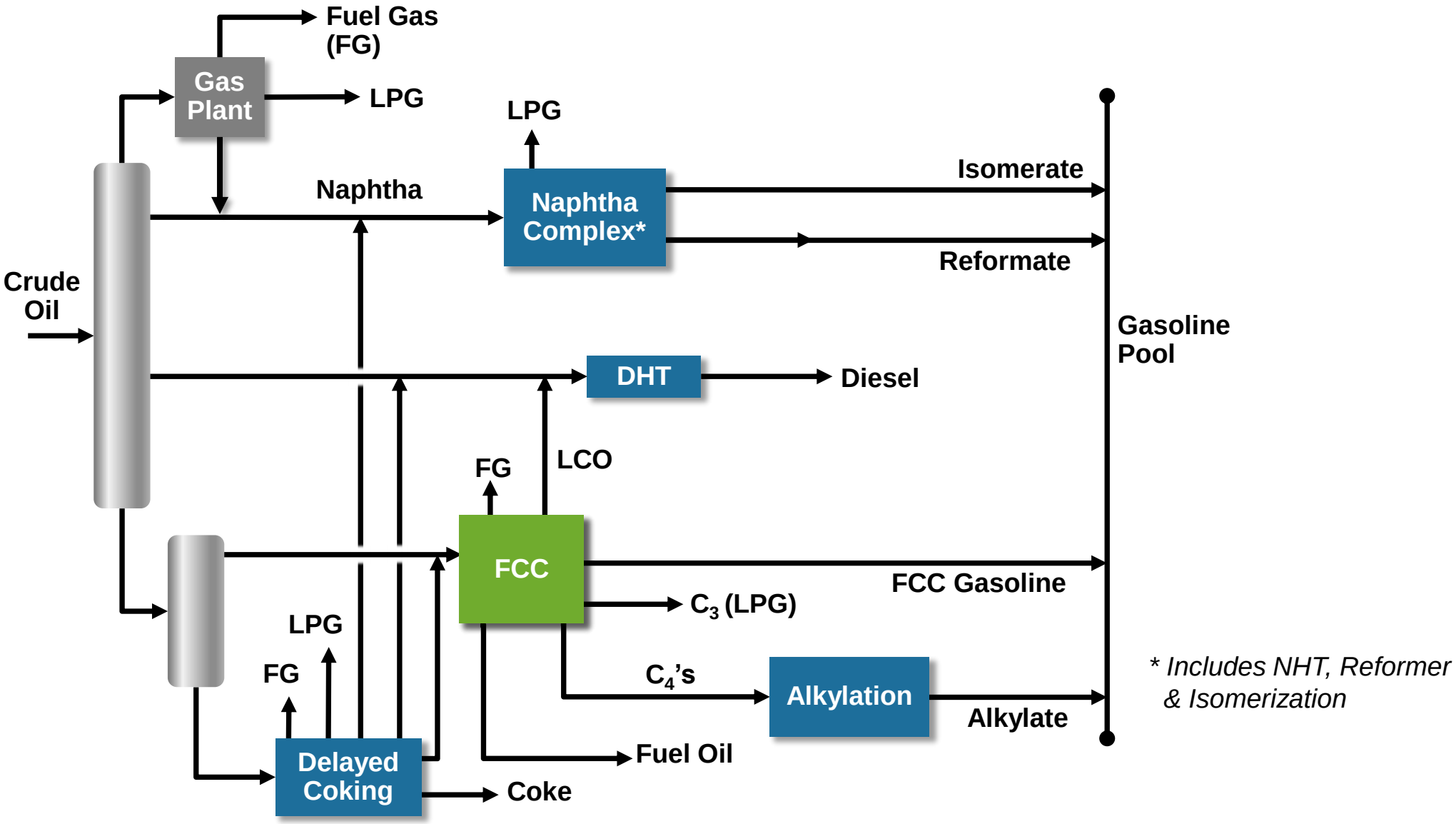
Molecule Management Drives Value through Selectivity, Yield Increases

An Integrated Fuels and Petrochemicals Complex



Broad flexibility to address fuels and petrochemical integration

Reconfiguring Towards Petrochemicals



** Includes NHT, Reformer & Isomerization*

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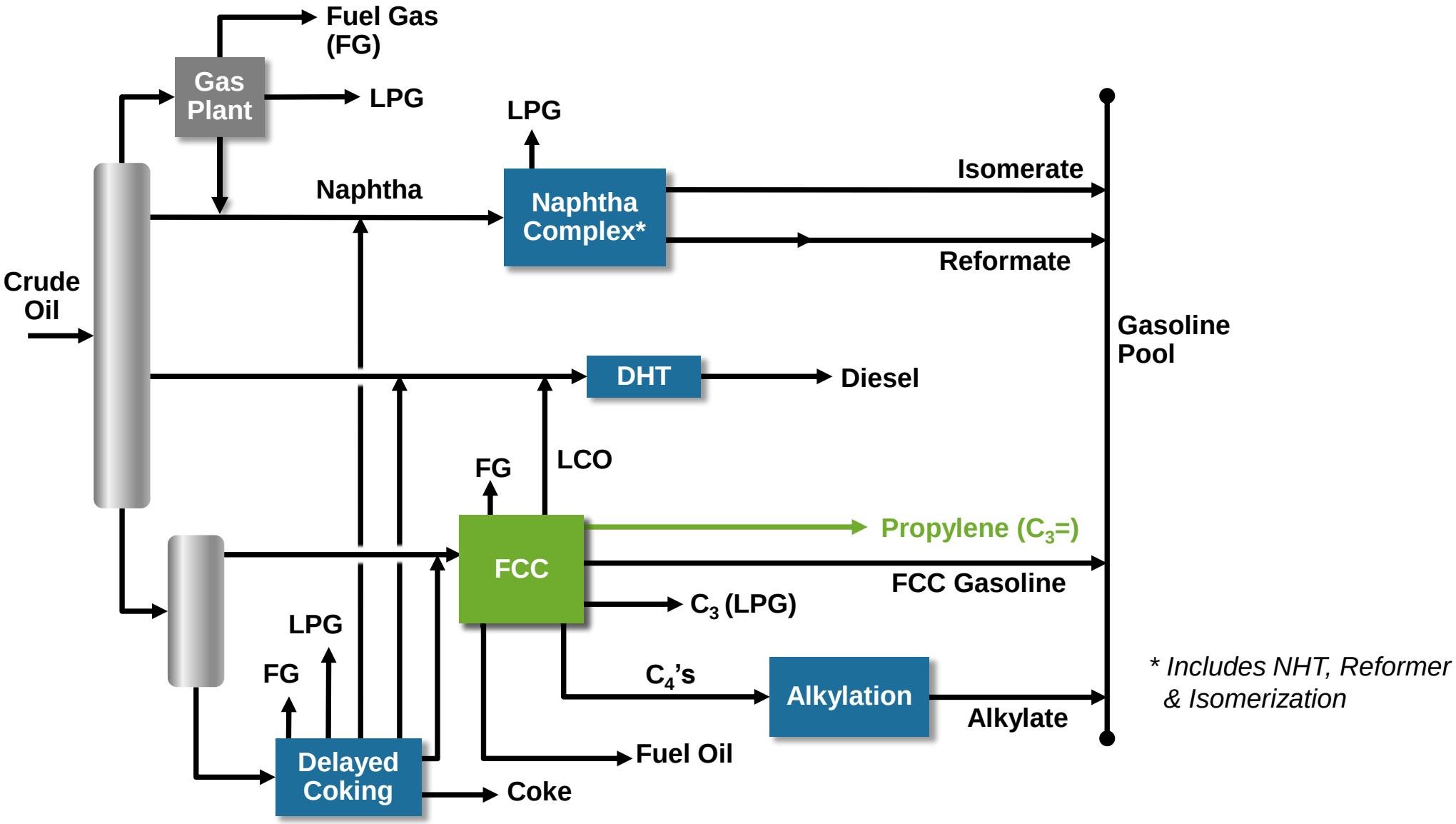
Reconfiguring Towards Petrochemicals



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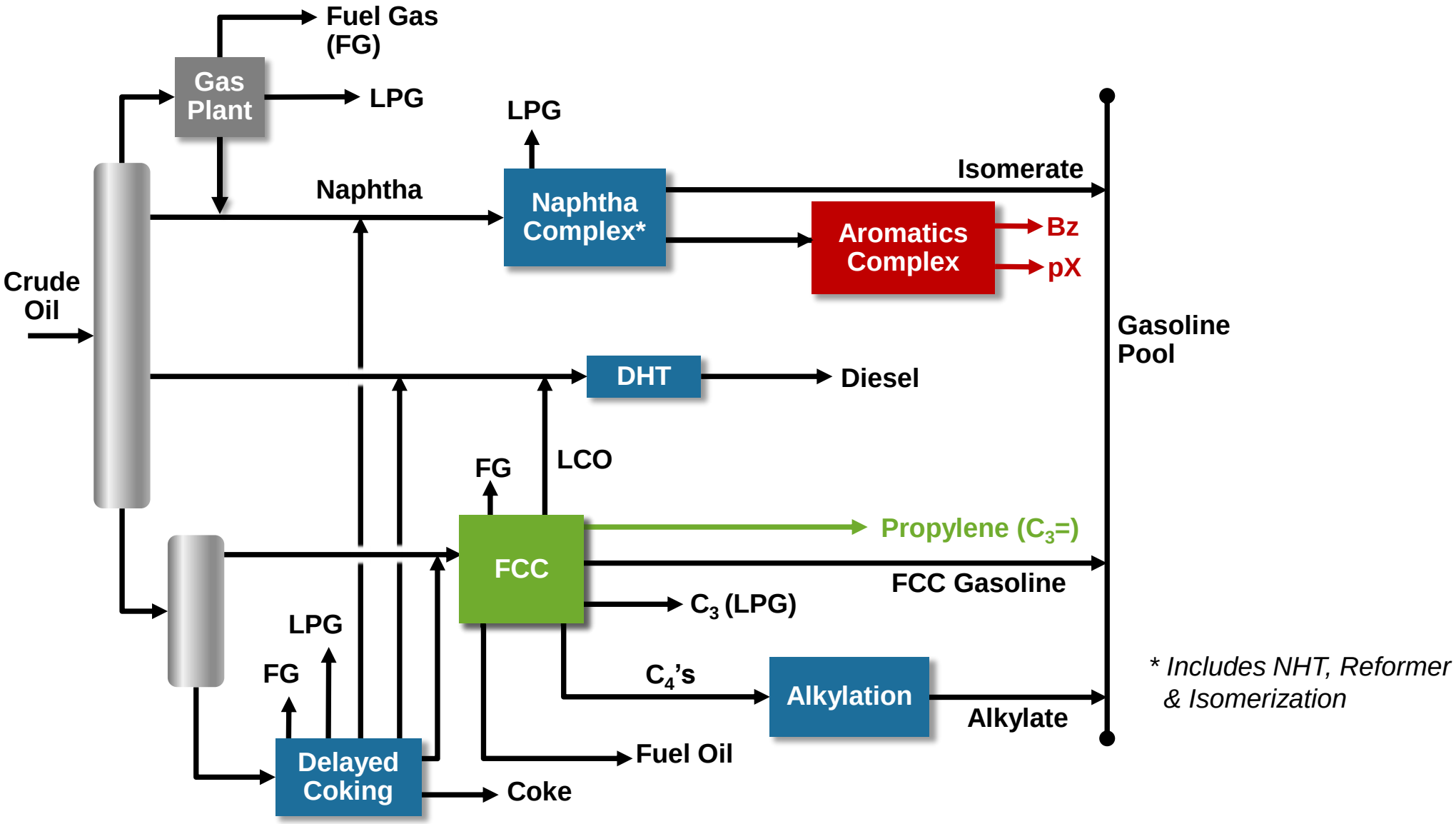

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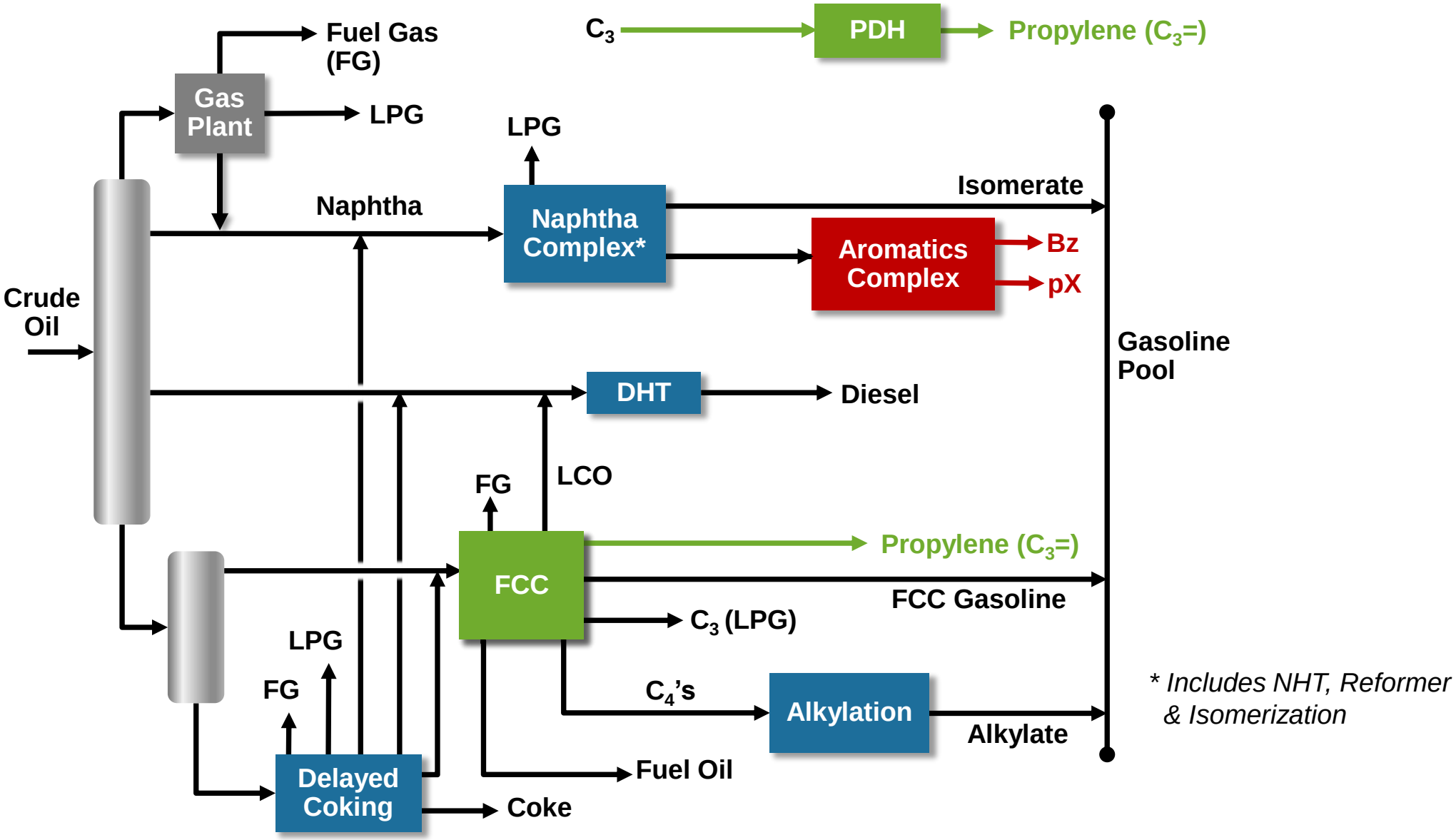

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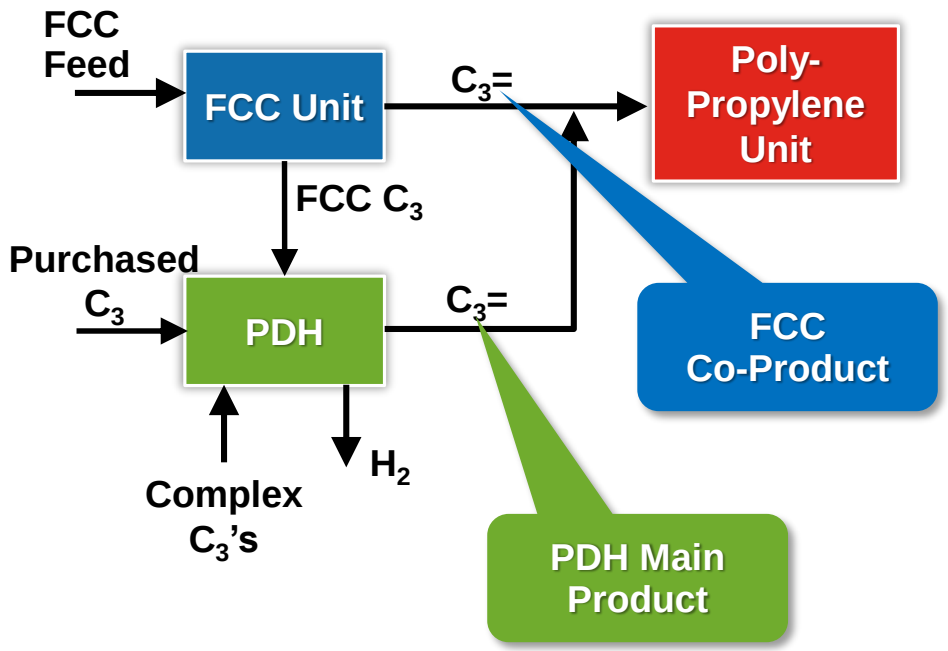
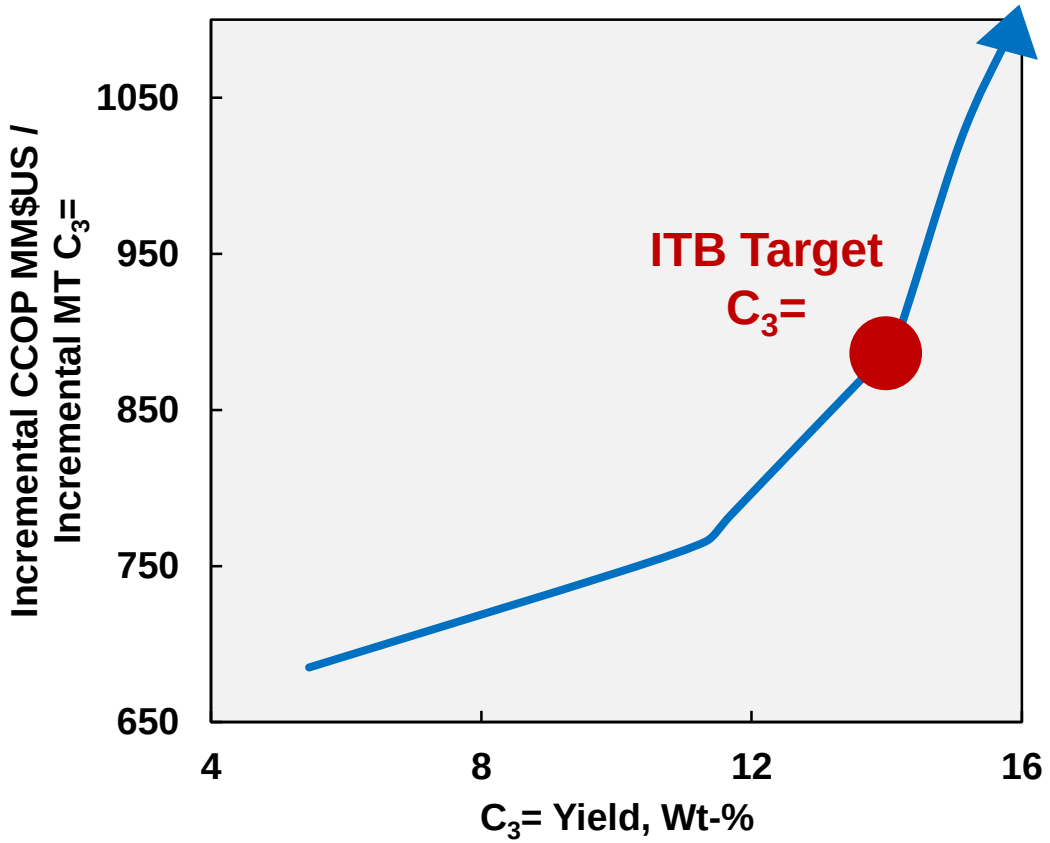
ITB Configuration Asked 1 MMTA C_3= with FCC at 14 Wt-% $C_3^=$

Integrated FCC & PDH (C_3 Oleflex™) Propylene ($C_3^=$) Production

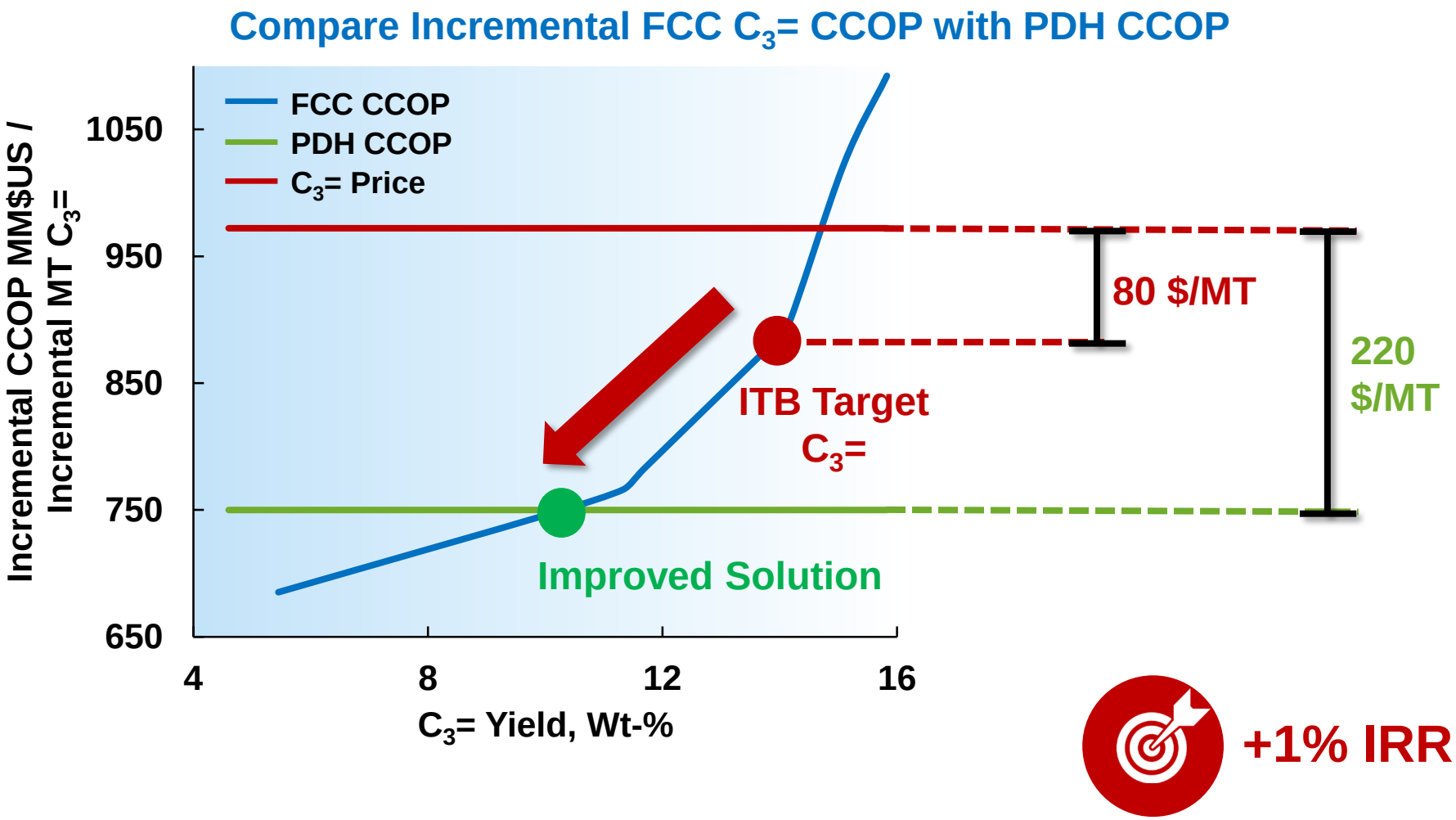


Incremental Cost of Producing Polymer Grade $C_3^=$ from a FCC



Achievable, Yes!…… but not Optimal

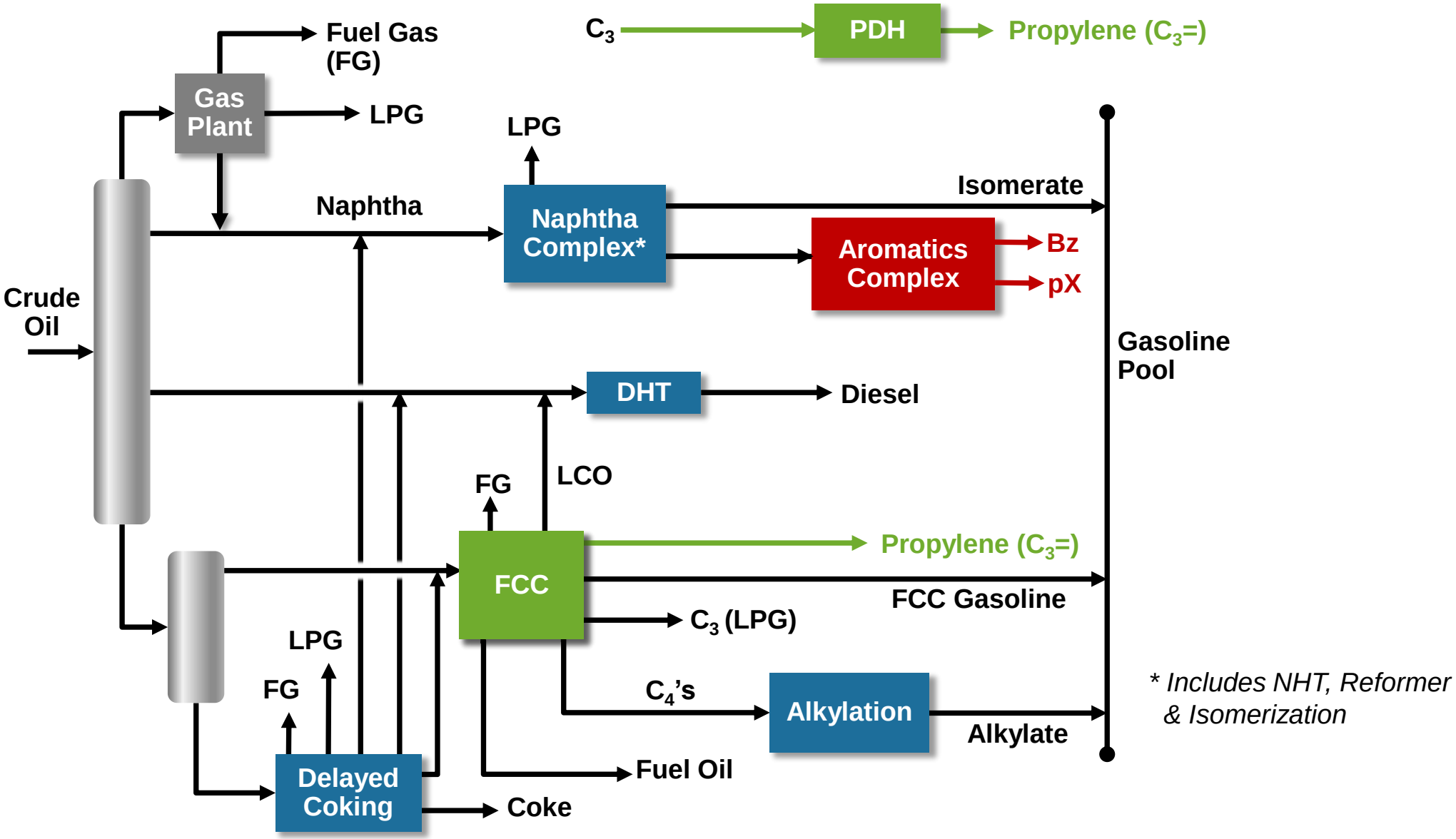
Balance FCC and PDH $C_3^=$ for Best Economics



+1% IRR

PDH integration enables improved FCC investment

Reconfiguring Towards Petrochemicals



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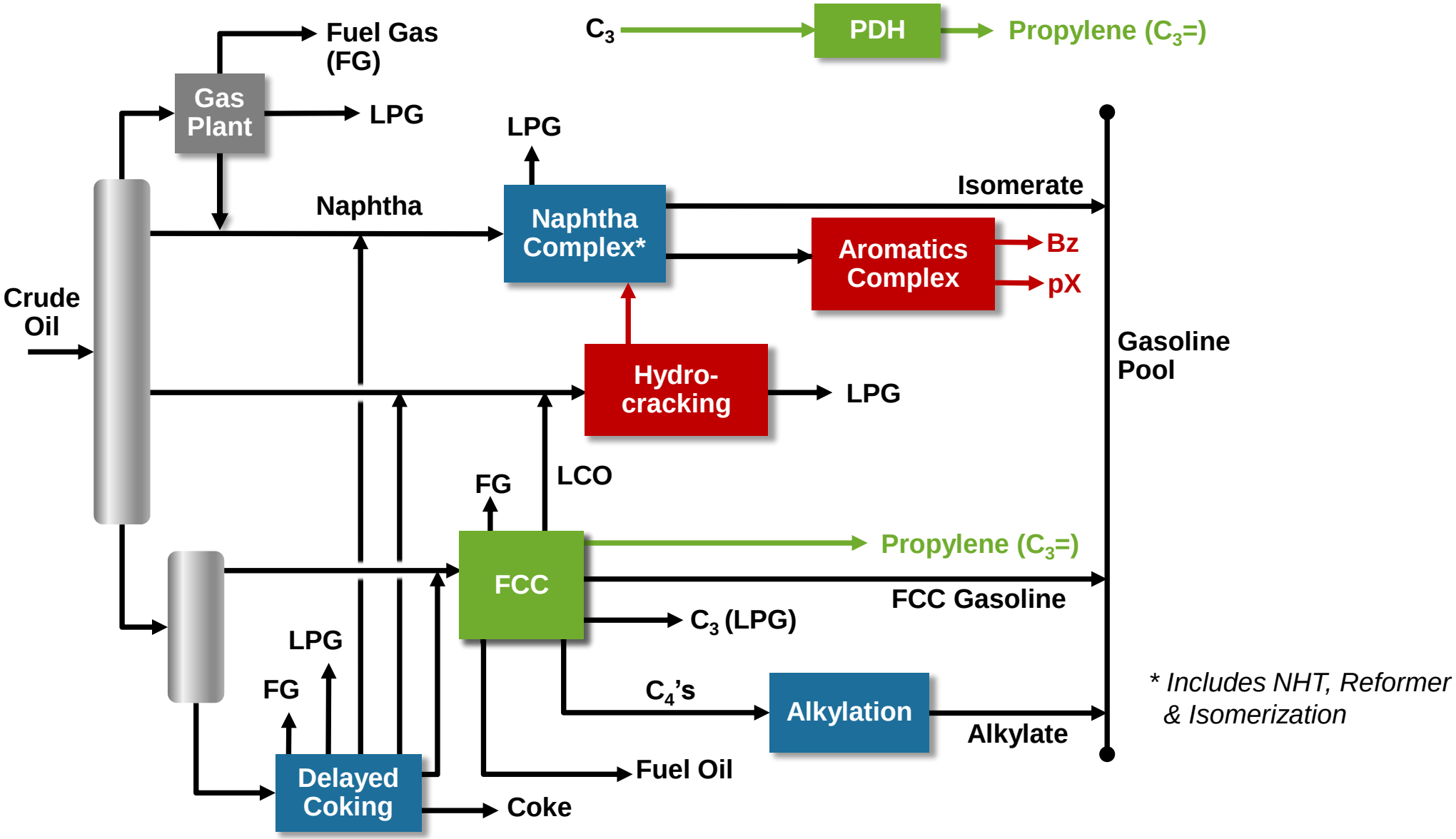
Reconfiguring Towards Petrochemicals



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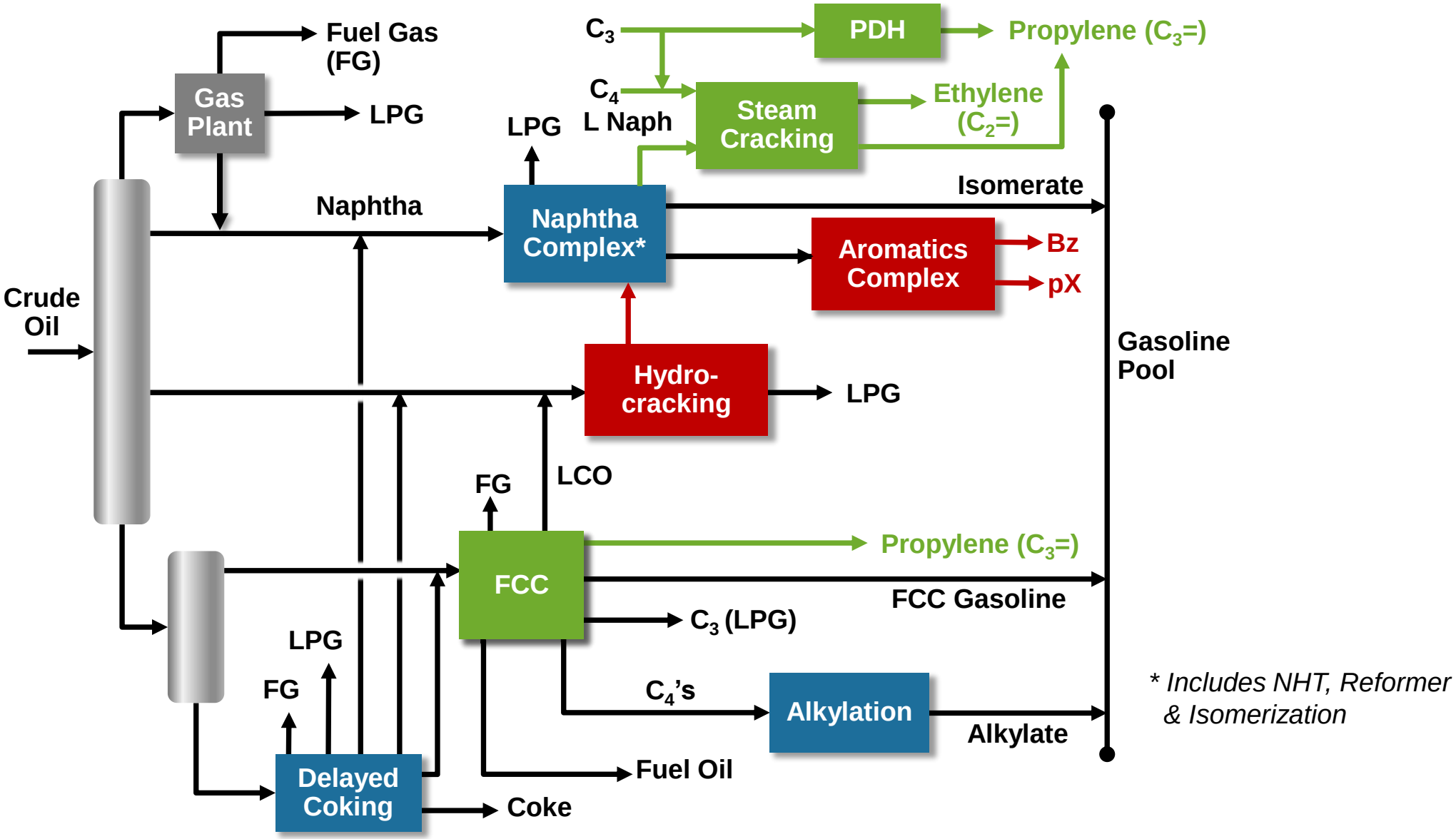
Reconfiguring Towards Petrochemicals



** Includes NHT, Reformer & Isomerization*

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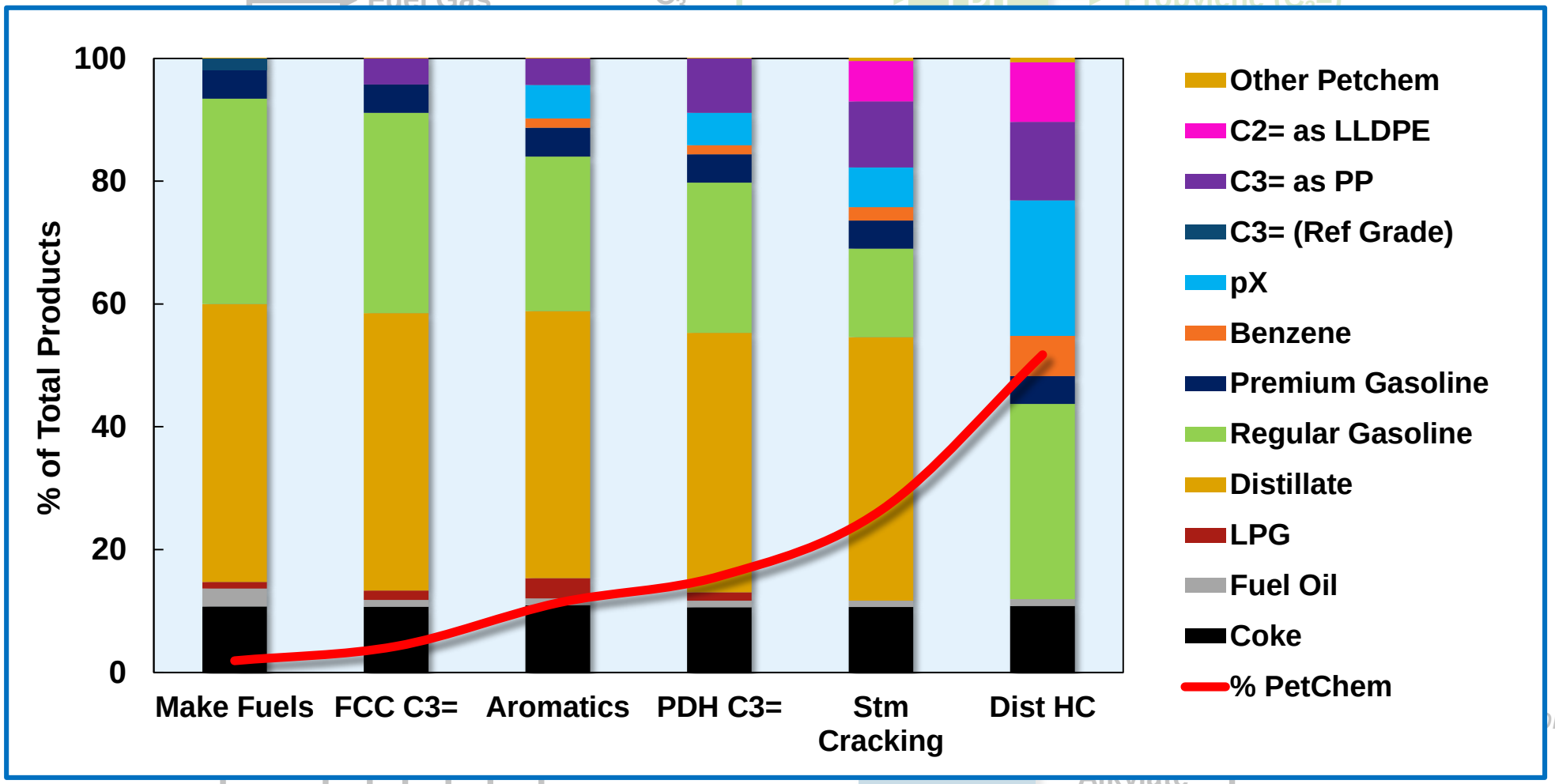
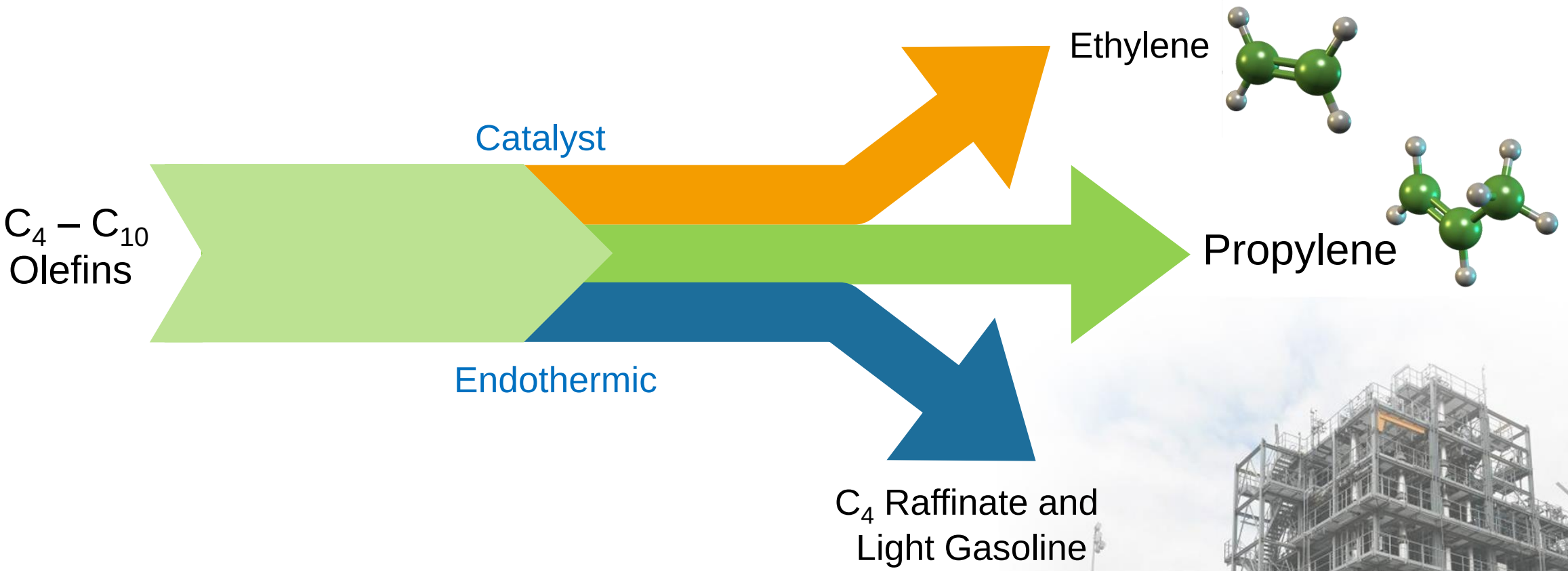
Reconfiguring Towards Petrochemicals



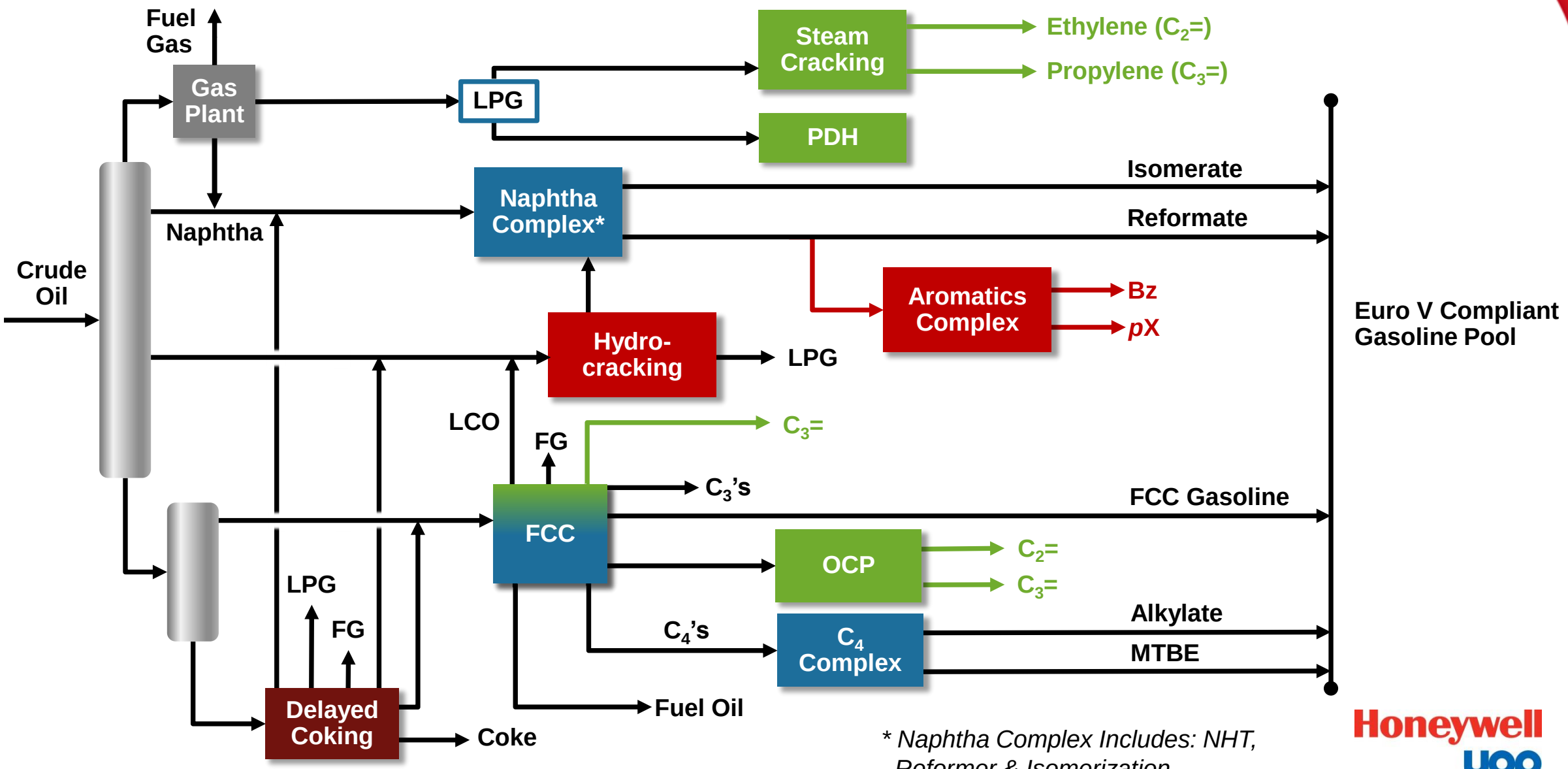
Continuing to Create Options for Reconfiguration

Total/UOP Olefin Cracking Process (OCP)



A proven alternative for upgrading C_4+ Olefins

Integrated Fuels and Petrochemicals



** Naphtha Complex Includes: NHT, Reformer & Isomerization*

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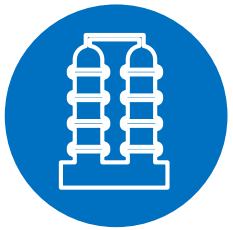
Bottoms Upgrading for Chemicals – Case Study

Goals: 

- Petrochemical Feedstocks
  - Aromatics Now
  - Olefins Later addition
- Minimum Plot space
- Low Capex and Opex
- Crude to Petrochem Efficiency
  - Low fuels make
  - Quality fuels products required
  - No Fuel Oil Production

Units Needed: 

- Hydrocracking / Reforming
  - Heavy feeds (VGO and Diesel) to naphtha
  - Reform naphtha to aromatics
- High severity FCC for olefins
  - High H_2 content drives yields
- VR conversion – Resid HC
  - Make more feed for above
  - No fuel oil production

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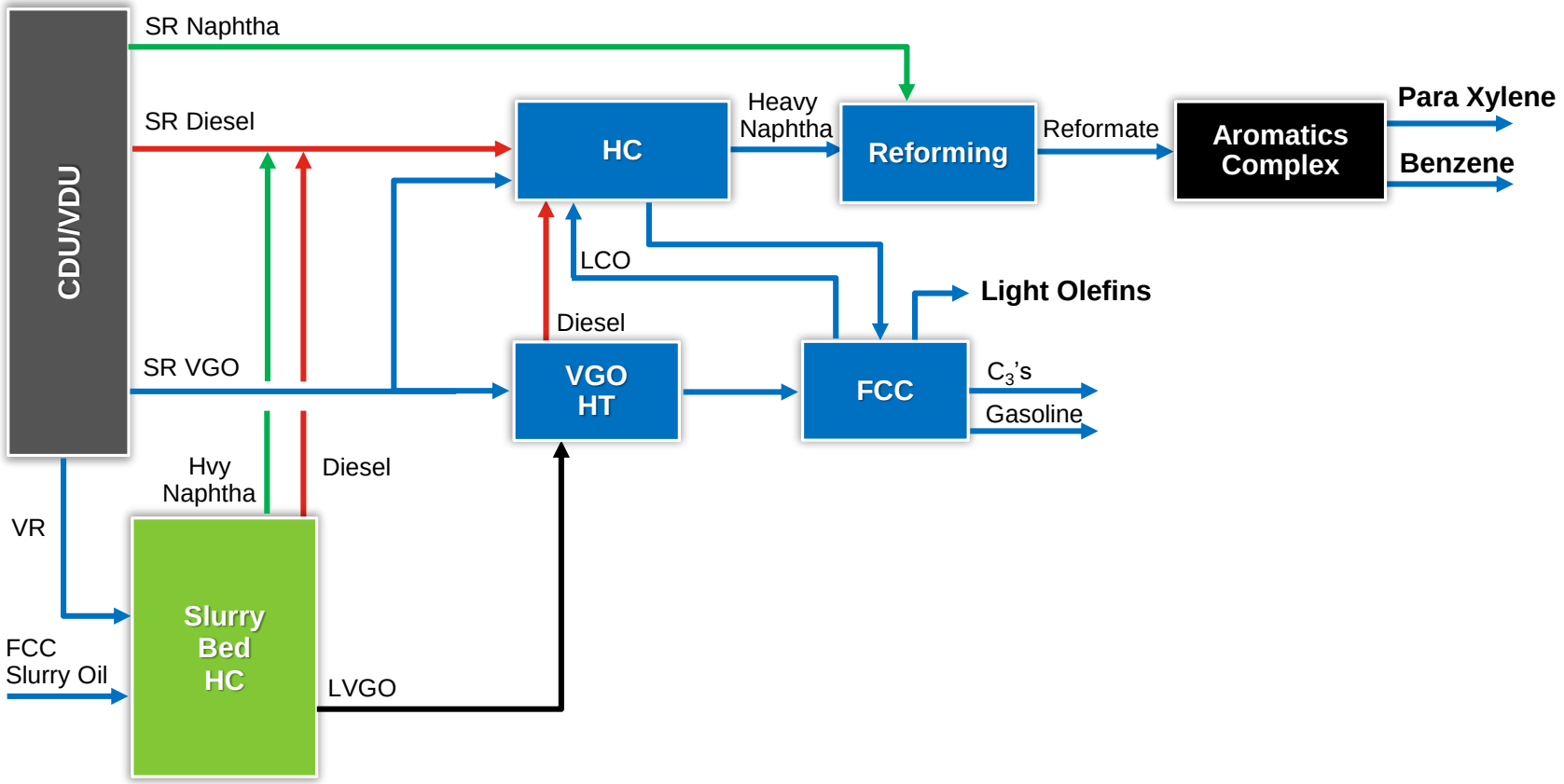
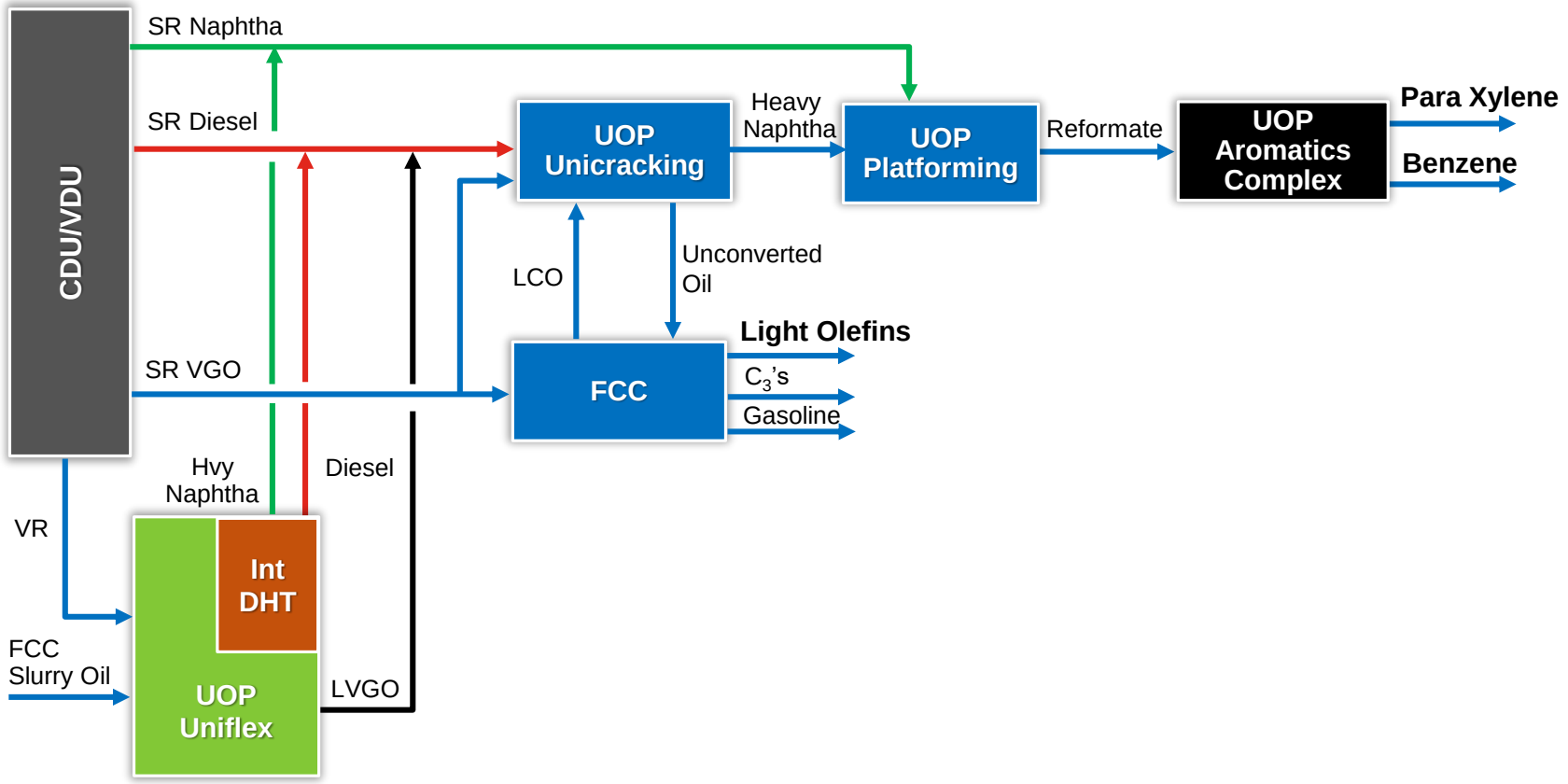
Original Customer Configuration - Not Optimized



Residue Hydrocracking Unit

- Products need upgrading
- High production of VGO requires separate VGO HT
- Naphtha sent to HCU for treating
  - Over cracking
- Diesel to HC required large Pretreat reactor

Final Customer Configuration Less Complex – Better Yields

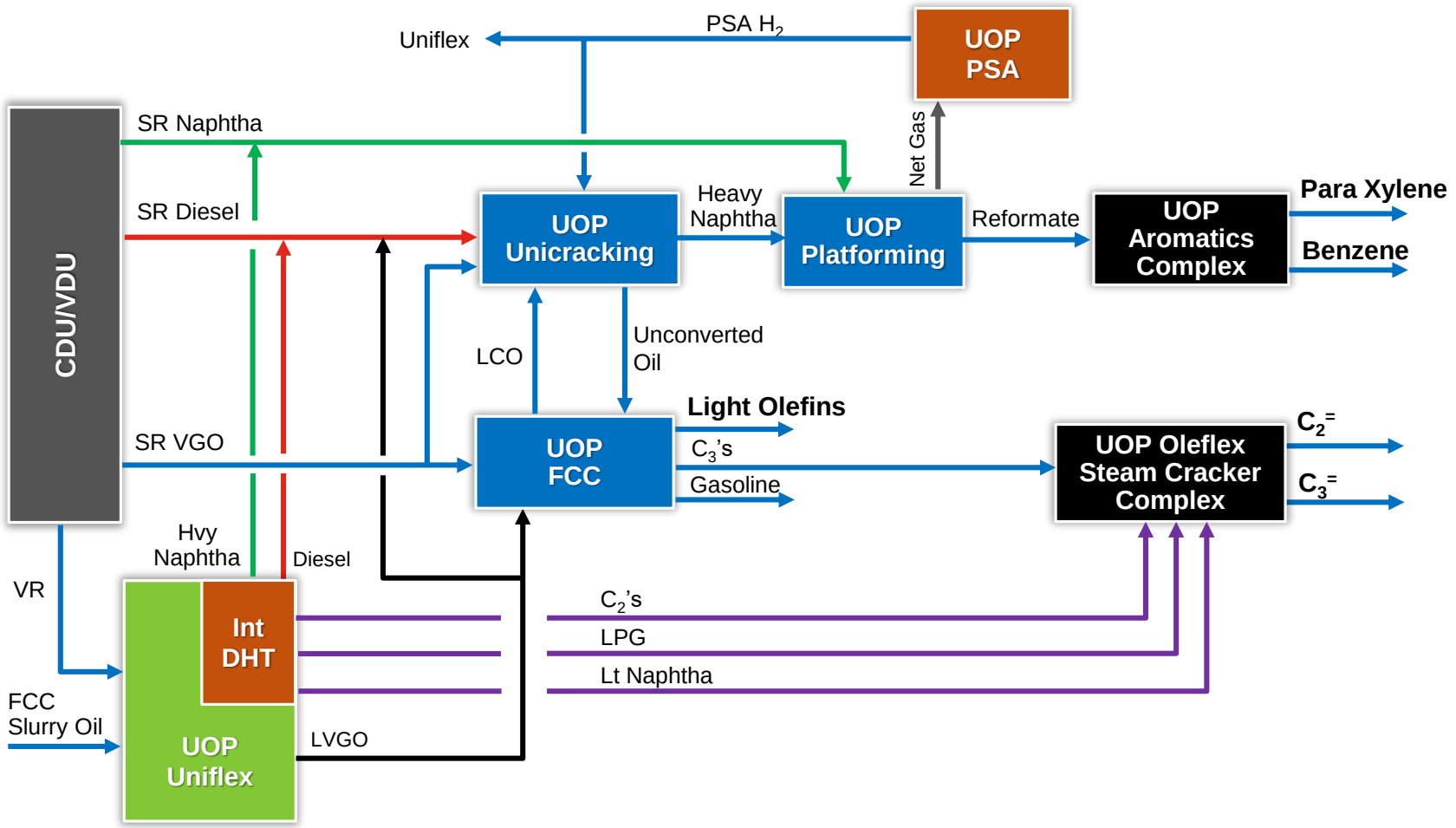


- Better integration between UOP Uniflex + UOP Unicracking Process + UOP CCR Platformer + Aromatics Complex drives lower CAPEX and OPEX

Uniflex MC Slurry HC Unit

- Integrated HT
  - Low Capex and Opex
  - Small foot print
  - Diesel and lighter products treated
- Naphtha directly to Platforming unit
- LVGO and SR VGO to HCU 1st Stage
- Diesel to HCU 2nd Stage
- No pretreat for N and D
- Reduced VGO make, no VGO HT required

Fully-integrated Complex Maximizes Product Value / ROI



Olefins Complex

- Fed by FCC and Uniflex MC SHCU
- Uniflex Diesel and lighter products treated
- Uniflex C_2, LPG, Light Naphtha high in n-paraffin content, high olefin yields

The Refinery of the Future Is…

Flexible to meet **rapidly changing markets** for fuels and other products

- Maximum crude/ feedstock flexibility
- Minimum residual products
- Meet increasing renewable obligations

Integrated with petrochemicals to achieve **higher margins** and **value**

- Molecular management
- Produce petrochemicals as a feedstock
- Potential to capture further value from polymer production
- Play its part in the plastics circular economy

Adaptable to future markets and capturing the greatest value from every molecule


Q&A