

REFINING TECHNOLOGIES ACCELERATING THE SHIFT TOWARDS CHEMICALS

KEITH A. COUCH

SENIOR DIRECTOR, BUSINESS DEVELOPMENT

Honeywell

World Chemical Forum 2023 | Marriott Marquis | Houston, Texas

Forward Looking Statements

This presentation contains certain statements that may be deemed “forward-looking statements” within the meaning of Section 21E of the Securities Exchange Act of 1934. All statements, other than statements of historical fact, that address activities, events or developments that we or our management intends, expects, projects, believes or anticipates will or may occur in the future are forward-looking statements. Such statements are based upon certain assumptions and assessments made by our management in light of their experience and their perception of historical trends, current economic and industry conditions, expected future developments and other factors they believe to be appropriate. The forward-looking statements included in this presentation are also subject to a number of material risks and uncertainties, including but not limited to economic, competitive, governmental, technological, and COVID-19 public health factors affecting our operations, markets, products, services and prices. Such forward-looking statements are not guarantees of future performance, and actual results, and other developments, including the potential impact of the COVID-19 pandemic, and business decisions may differ from those envisaged by such forward-looking statements. Any forward-looking plans described herein are not final and may be modified or abandoned at any time. We identify the principal risks and uncertainties that affect our performance in our Form 10-K and other filings with the Securities and Exchange Commission.

THE **REFINERY** OF THE FUTURE IS...



BANKABLE

TO SECURE THE CASH
NEEDED TO DEVELOP
THE PROJECT

SUSTAINABLE

DOING MORE WITH LESS –
ALIGNED WITH ESG OBJECTIVES



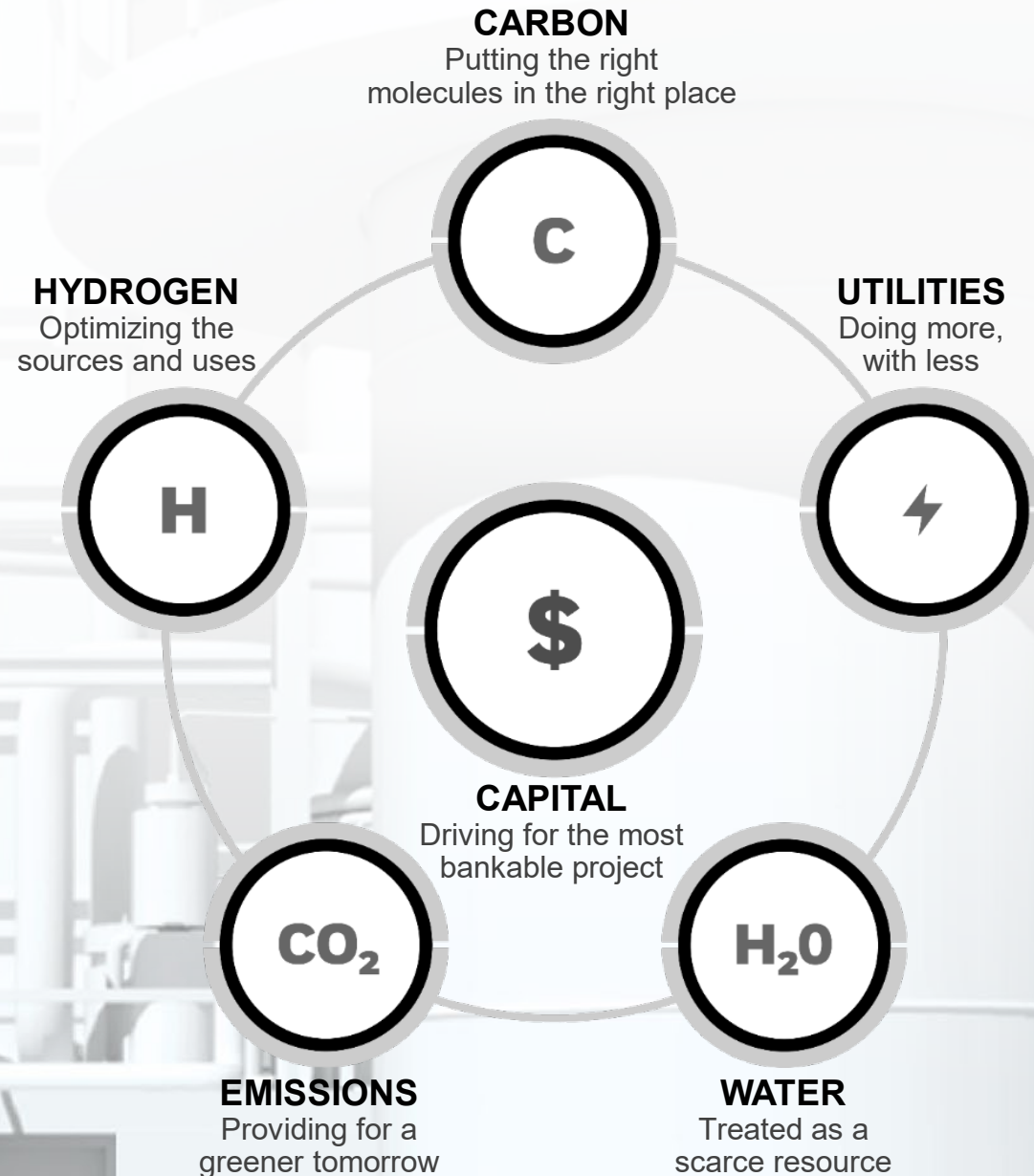
FLEXIBLE

TO ACHIEVE HIGHER MARGINS
AND VALUE EVERY DAY

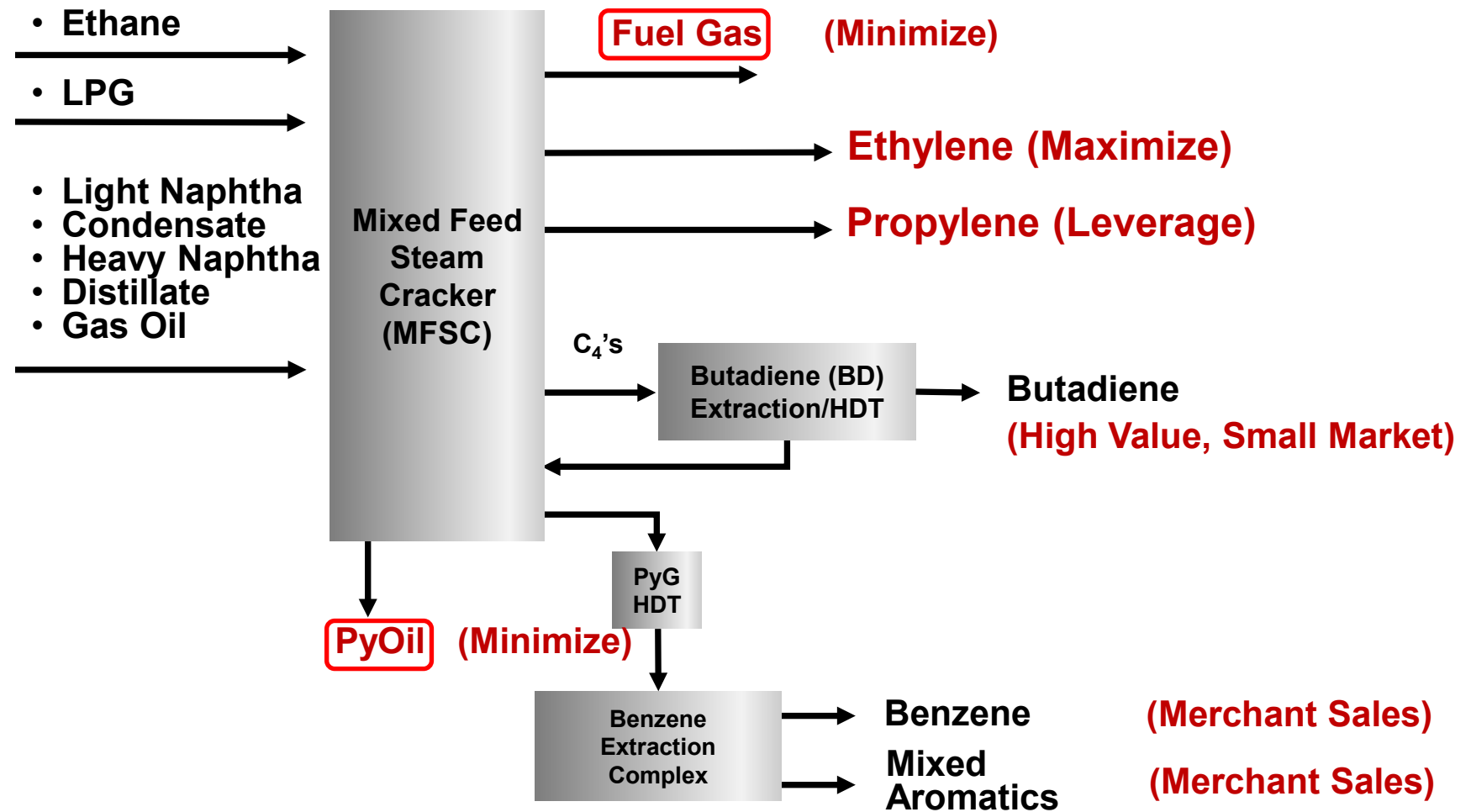
Leverage assets, anticipate markets, & guide each molecule to greatest value

6

EFFICIENCY METRICS FOR BUSINESS ALIGNMENT ON ALL LEVELS



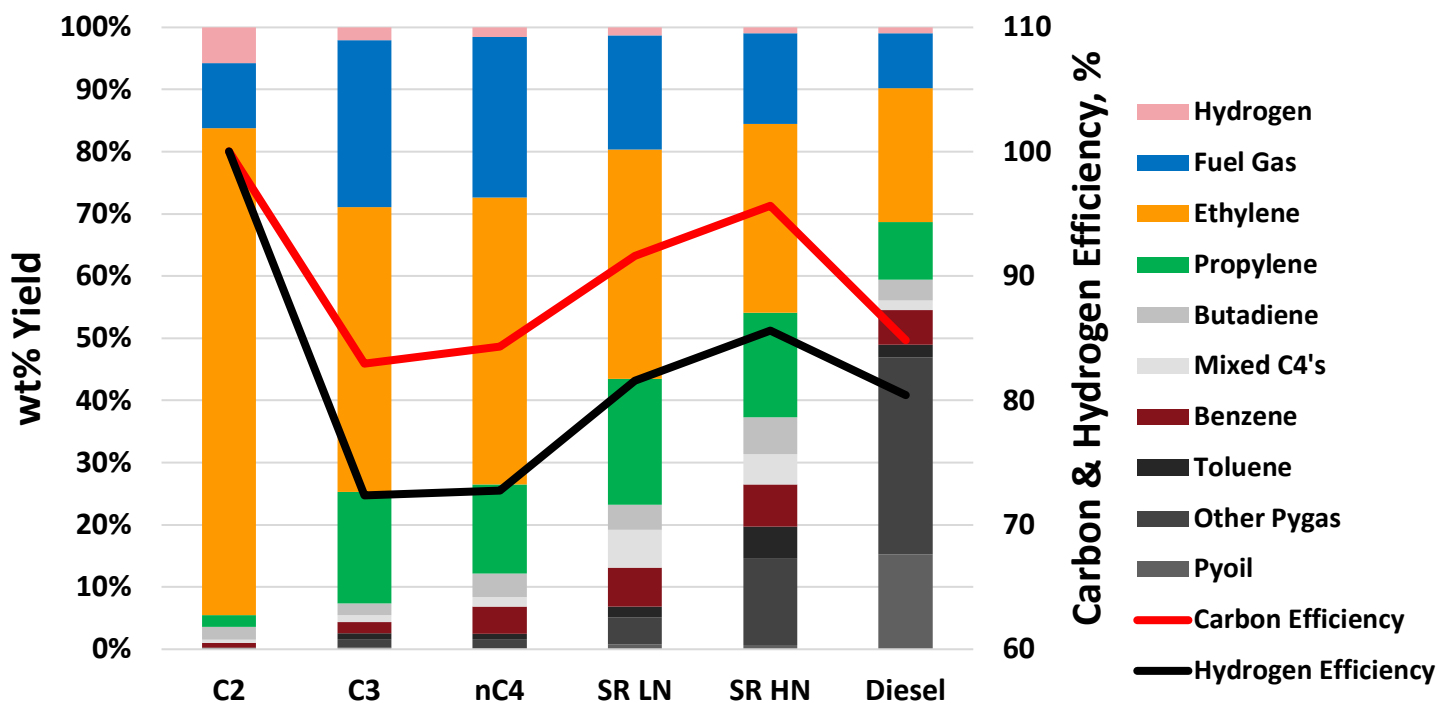
EXAMPLE: MIXED FEED STEAM CRACKER



Steam Cracker yields are highly dependent on feedstock

PUT THE RIGHT **CARBON NUMBER** IN THE RIGHT PROCESS UNIT

Steam Cracker Yields & C/H Efficiencies By Feed



We Want:

- More C2= & C3= (■ , ■)

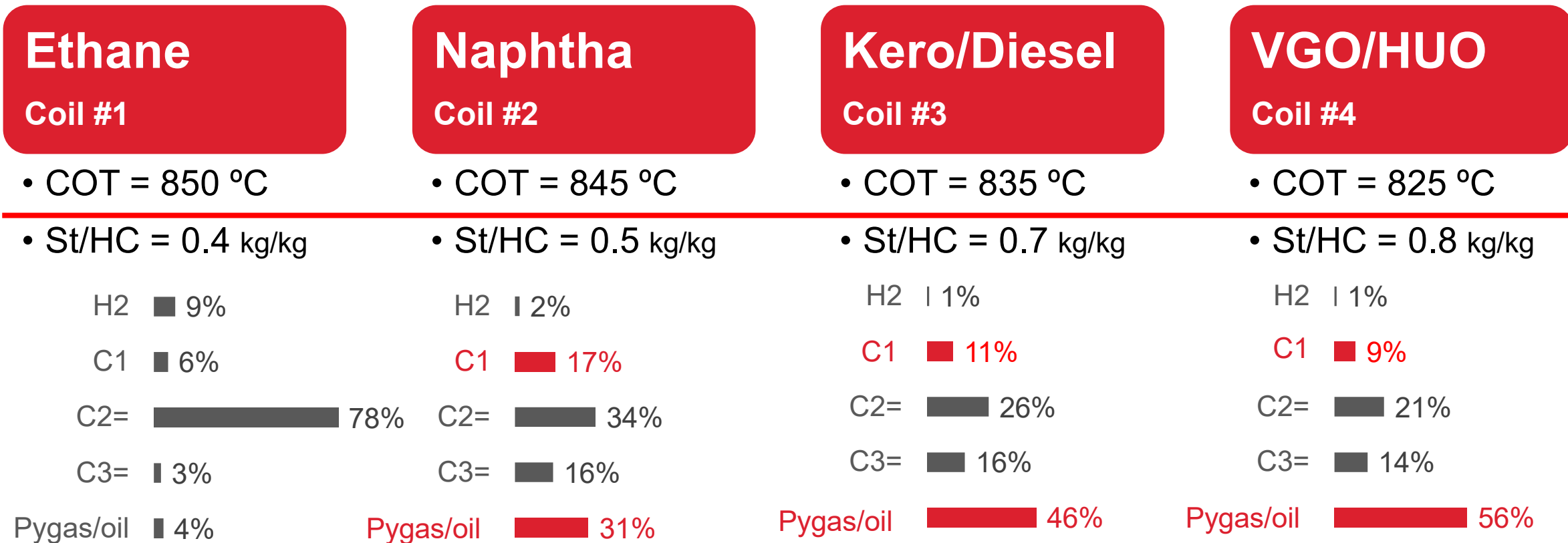
We Do Not Want:

- Fuel Gas (■);
 - FG is a carbon and hydrogen thief
- C5+ (■)

Steam Crackers like ethane, followed by light naphtha feedstocks, but not LPG

STEAM CRACKING

AN ENERGY INTENSIVE CONVERSION UNIT



1. Producing 80% LSD / 10% Gasoline / 10% LPG

2. CO₂ emissions estimated from refinery based on information from Linear Programing with utilities based on imported natural gas

3. From sources listed above in table

4. Based on customer study (ID000030) using UOP standard Linear Programming methods and customer data

Different feedstocks are optimized at different coil operation

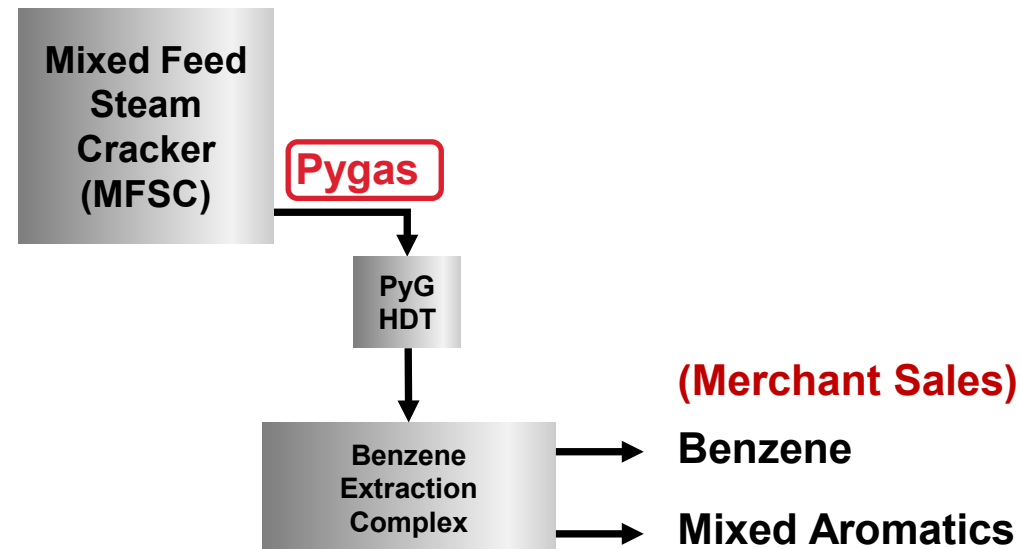
STEAM CRACKING PYGAS REDUCING PYGAS LOWERS CO₂ INTENSITY

Pygas is **3.6X more CO₂** intensive than naphtha Reforming

- Pygas: ~53% Aromatics
- Reformate: ~80% Aromatics

Pygas is **5.5X more CO₂** intensive per tonne of aromatics!

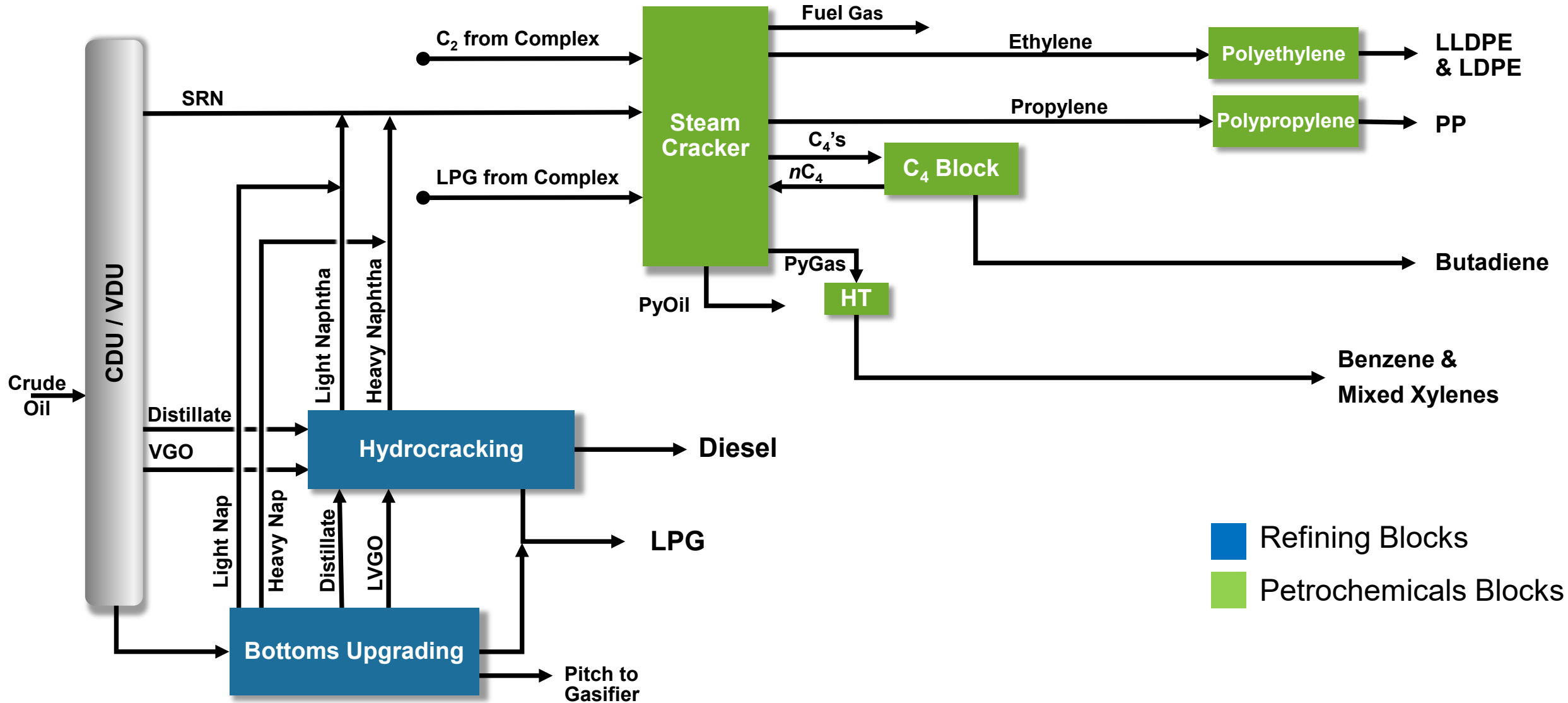
- High carbon intensity aromatics
- High carbon intensity gasoline blend stock



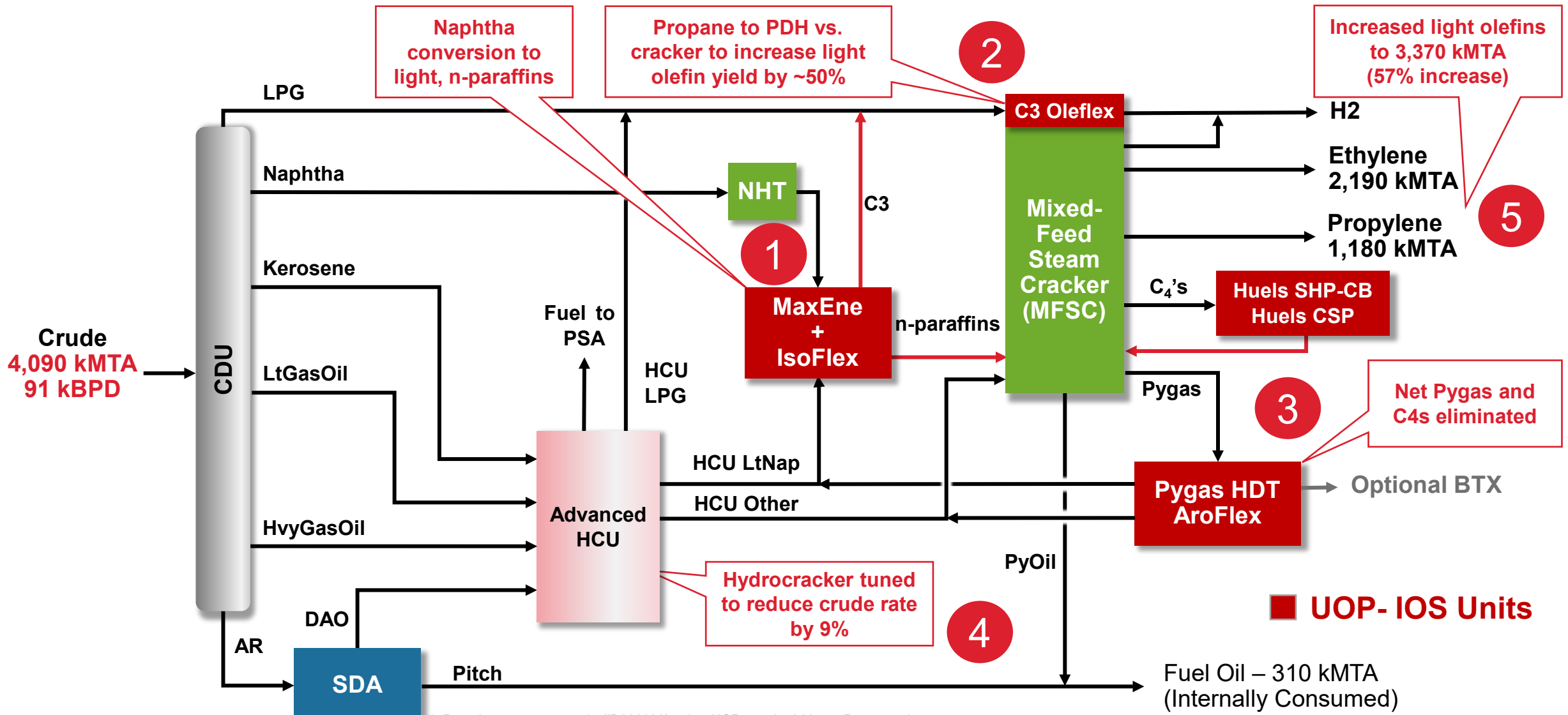
1. Scope 1 and 2 emissions calculated based on net power, fuel gas, steam, cooling water, BFW, and condensate use
2. 5.5 = CO₂ ratio for aromatics from pygas: aromatics from reformate = 0.47/0.53 / (0.13/0.8)
3. 1.2 = CO₂ ratio for burning cracker methane vs natural gas = (0.47/2205/19000 * 1e6 + 0.058) / 0.058 MTCO₂/MMBTU

If you want Aromatics... a reforming unit is a more sustainable option

BASE CASE CONVENTIONAL MIXED-FEED STEAM CRACKER



INTEGRATED OLEFINS SUITE MAXENE™, ISOFLEX™, AROFLEX™



1. Based on customer study (ID000030) using UOP standard Linear Programming methods and customer data and Murban crude
2. Proprietary yield data generated from kinetic model used to determine benefits

Honeywell Confidential - ©2023 by Honeywell International Inc. All rights reserved.

PROCESS C₃ IN OLEFLEX - NOT A STEAM CRACKER

C3 Oleflex vs C3 Steam Cracking:

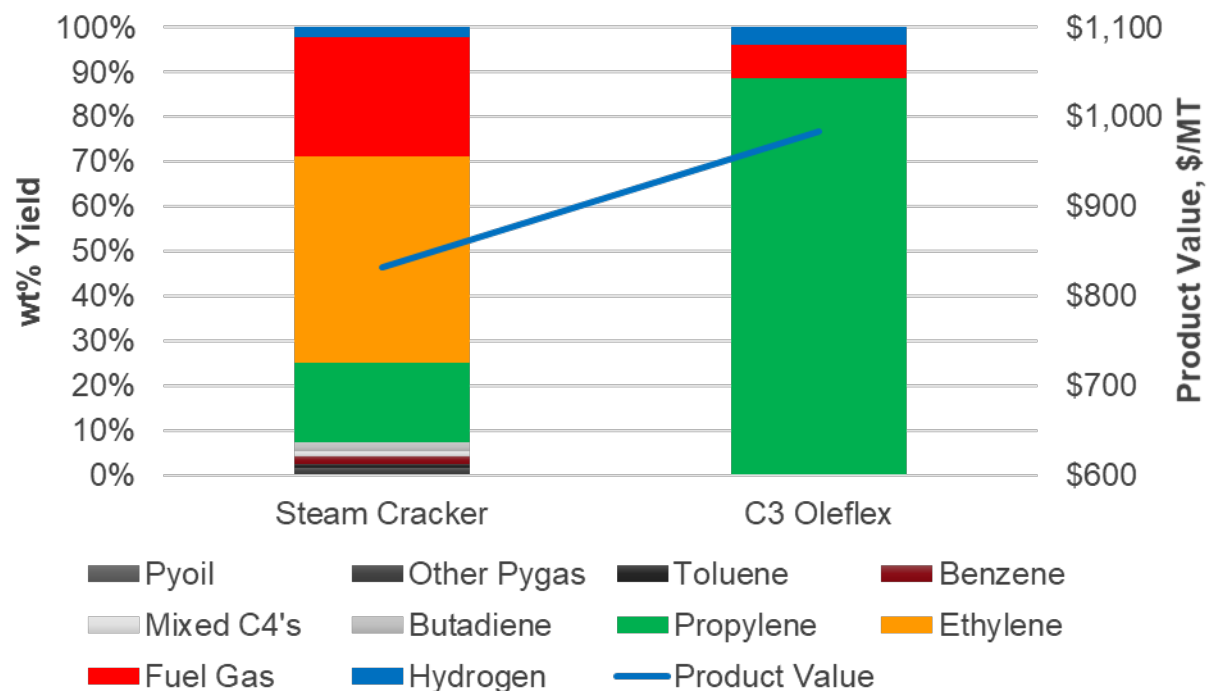
- Superior carbon & hydrogen efficiencies
- 75% less fuel gas/pyoil
- 90% more hydrogen
- 40% more light olefins



Superior value creation from the same feed stock

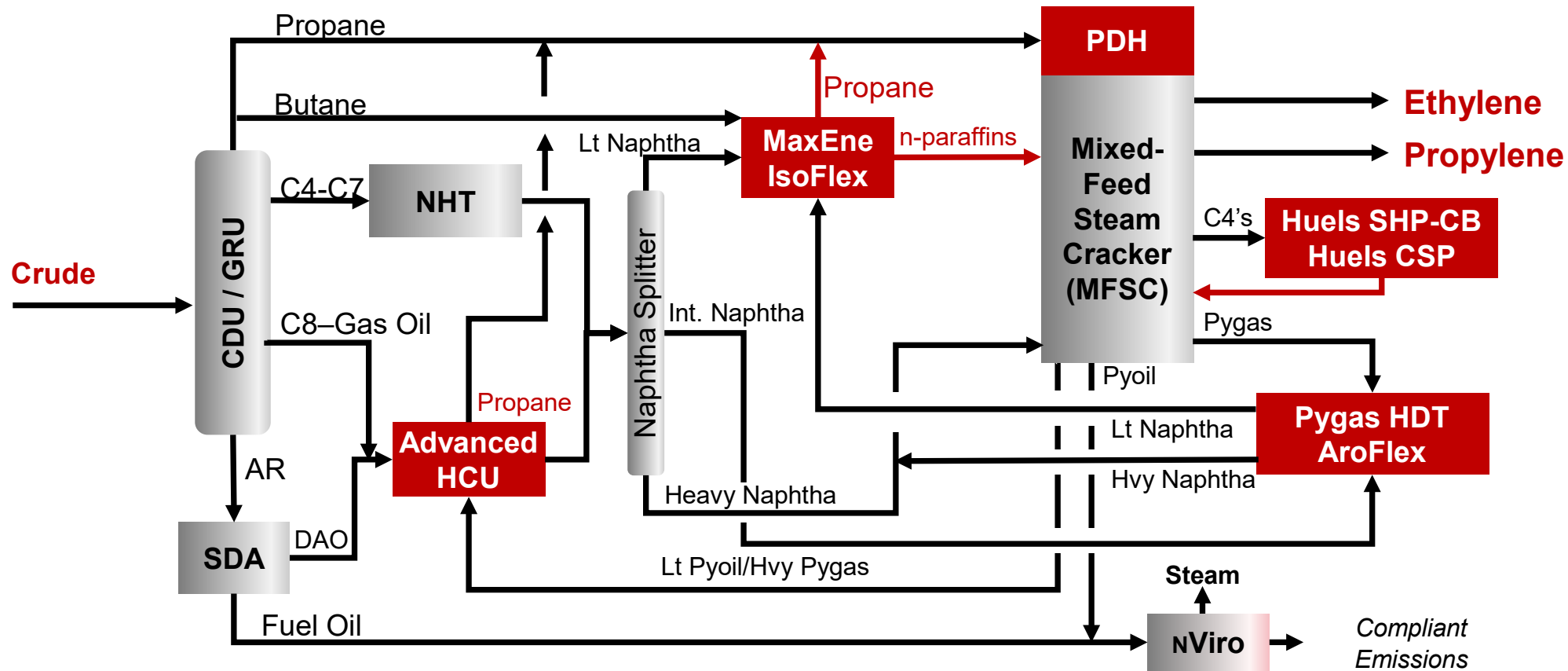
- \$150/MT higher Margin
- Lower capital/MT
- Significant IRR Improvement (**30%** vs. 16%)

C3 Steam Cracker versus Oleflex Yields & Total Product Value



Put the right molecule - in the right processes - to efficiently make the right products

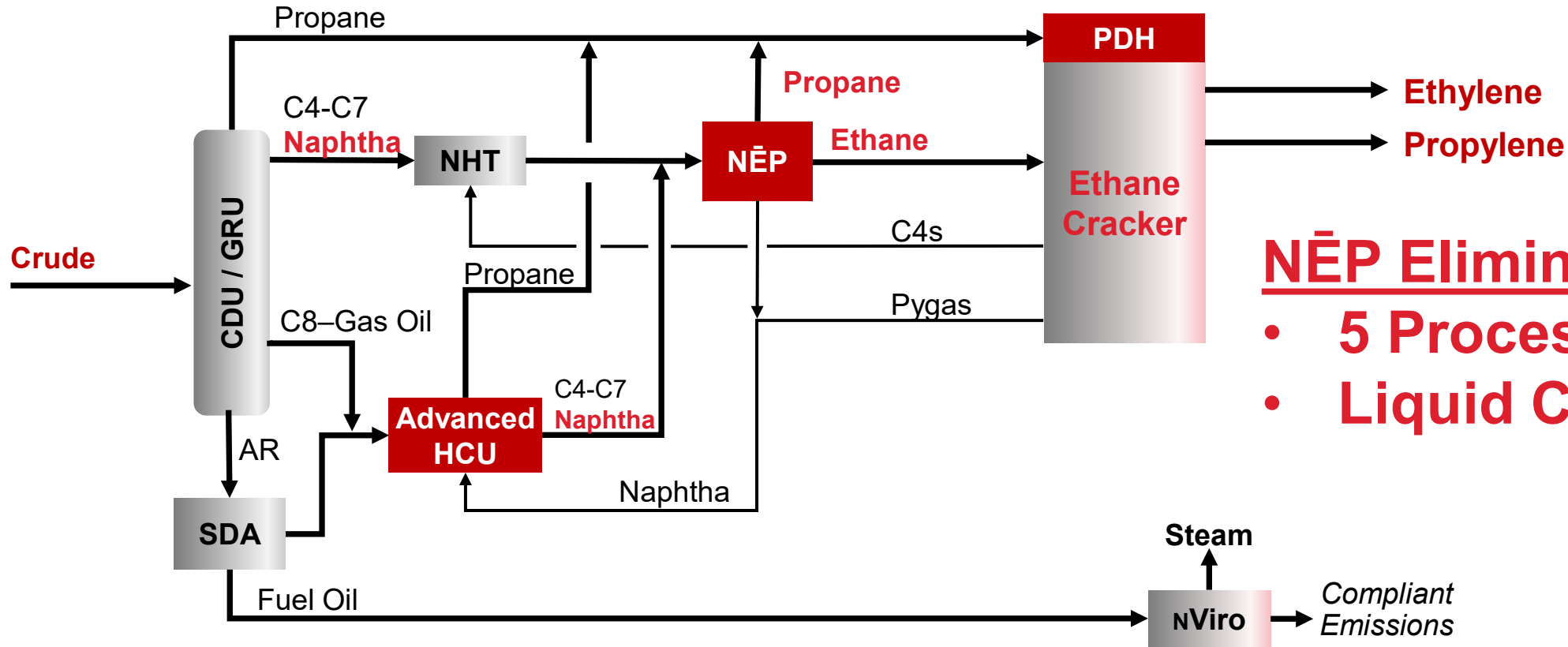
UOP IOS GEN-1 CRUDE TO LIGHT OLEFINS



■ UOP- IOS Units

Improved yields & economics with higher unit count... but we can do better!

NĒP-BASED CRUDE TO LIGHT OLEFINS



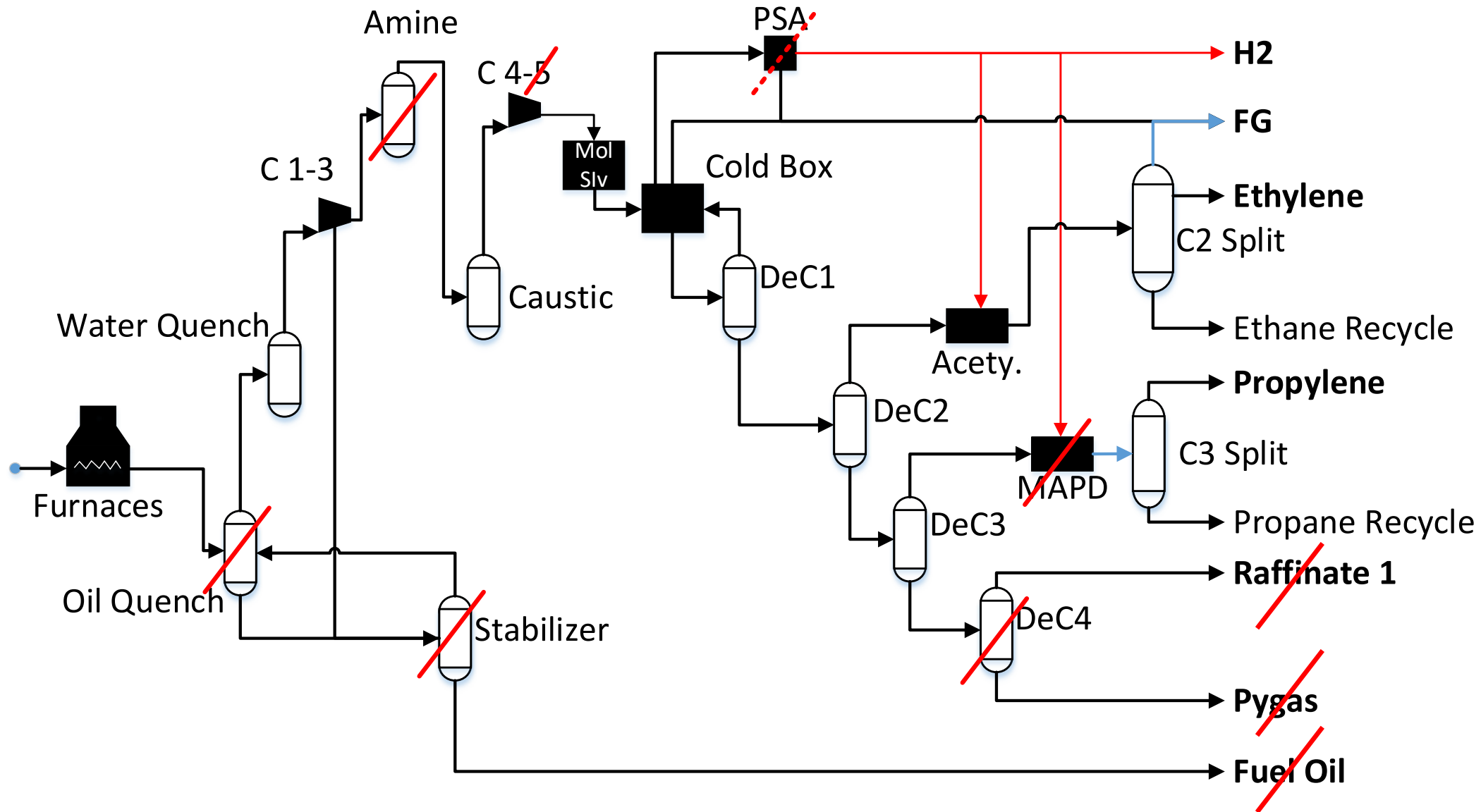
NĒP Eliminates:

- 5 Process Units
- Liquid Cracker

■ UOP- IOS Units

Major simplification with even better yields & economics

NAPHTHA VERSUS **ETHANE CRACKING SCOPE**

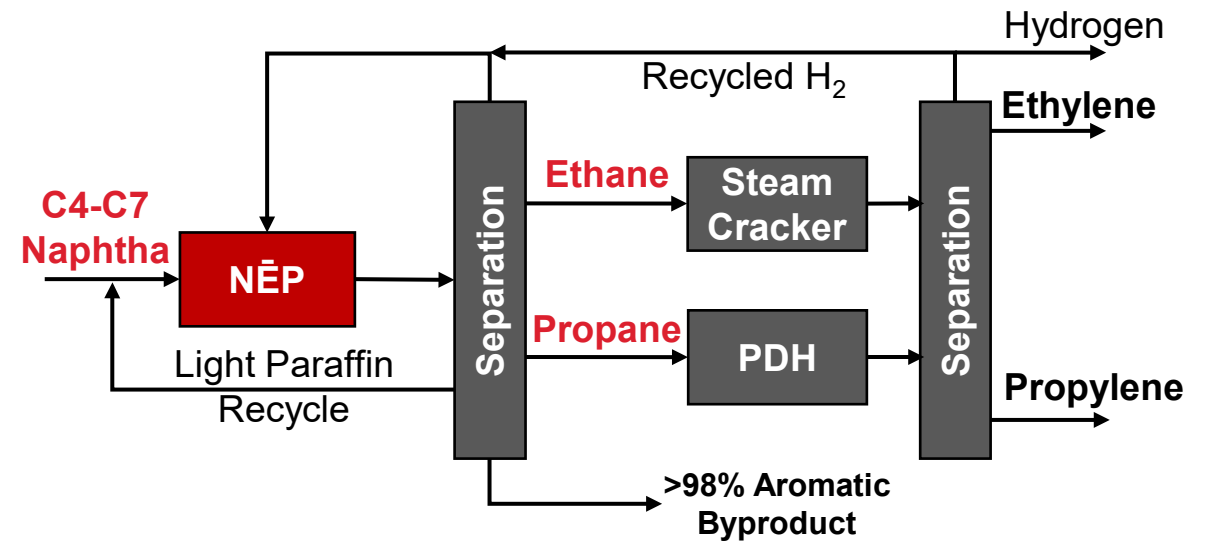


NAPHTHA TO ETHANE & PROPANE (NĒP) STEP-CHANGE ADVANCEMENT FOR OLEFIN INVESTMENTS

Compared to MFSC and other C2C investments:

- Lower CapEx via ethane vs liquid cracker
- Lower feed per tonne of light olefin
- Decarbonization with low-to-no byproducts
- Lowers CO₂ intensity per tonne of light olefin
- Wide range of E/P design flexibility
- Higher Net Cash Margin per bbl of crude

NĒP-Based Light Olefins Complex

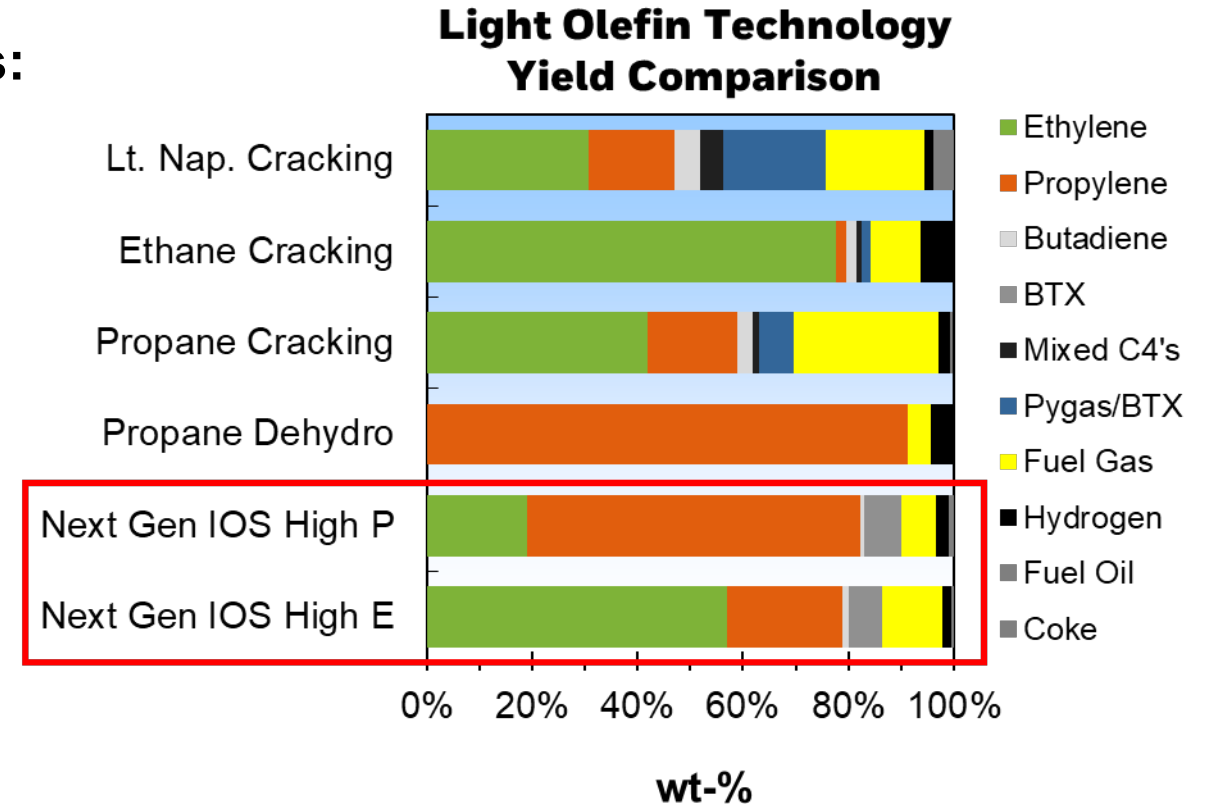


NĒP provides more bankable light olefins investments

NAPHTHA TO ETHANE & PROPANE (NĒP) STEP-CHANGE ADVANCEMENT FOR OLEFIN INVESTMENTS

Compared to MFSC and other C2C investments:

- Lower CapEx via ethane vs liquid cracker
- Lower feed per tonne of light olefin
- Decarbonization with low-to-no byproducts
- Lowers CO₂ intensity per tonne of light olefin
- Wide range of E/P design flexibility
- Higher Net Cash Margin per bbl of crude

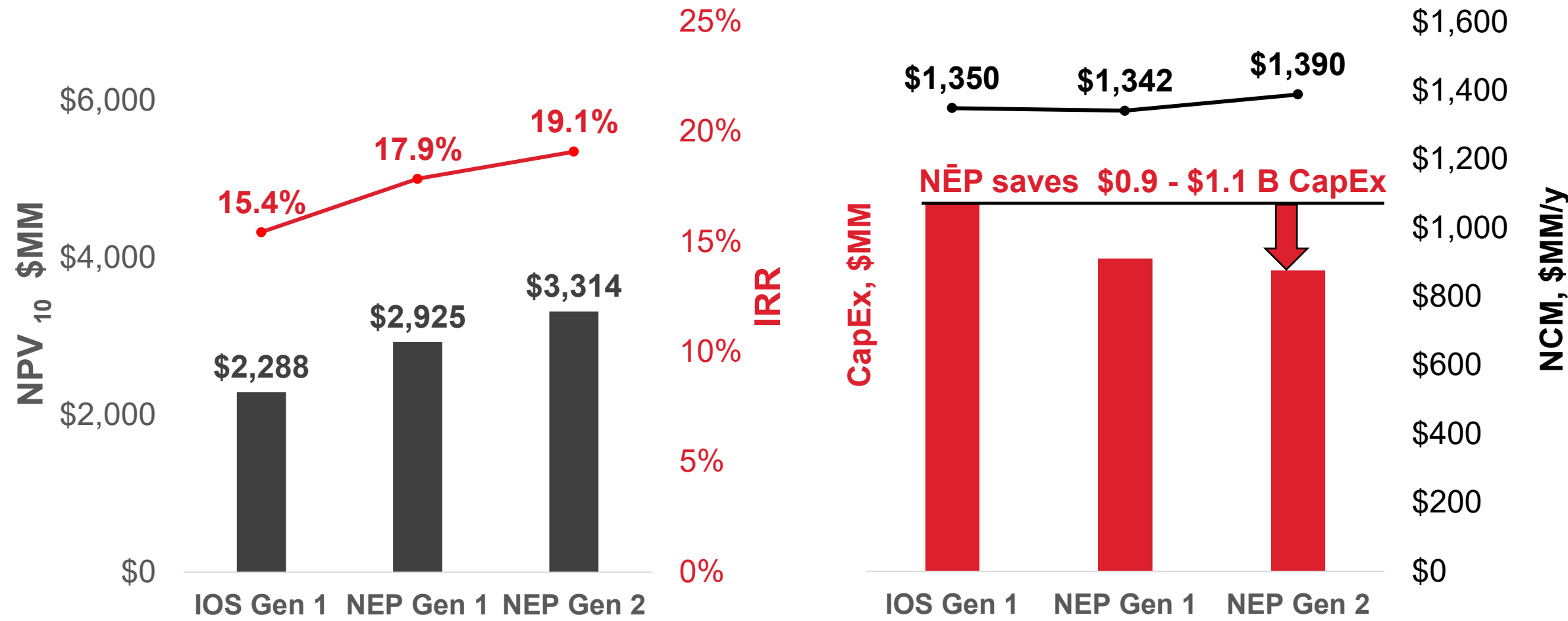


We Want: More C2= & C3= (■, ■)

NĒP provides more bankable light olefins investments

ECONOMICS FOR C2C NĒP VS. GEN 1 IOS

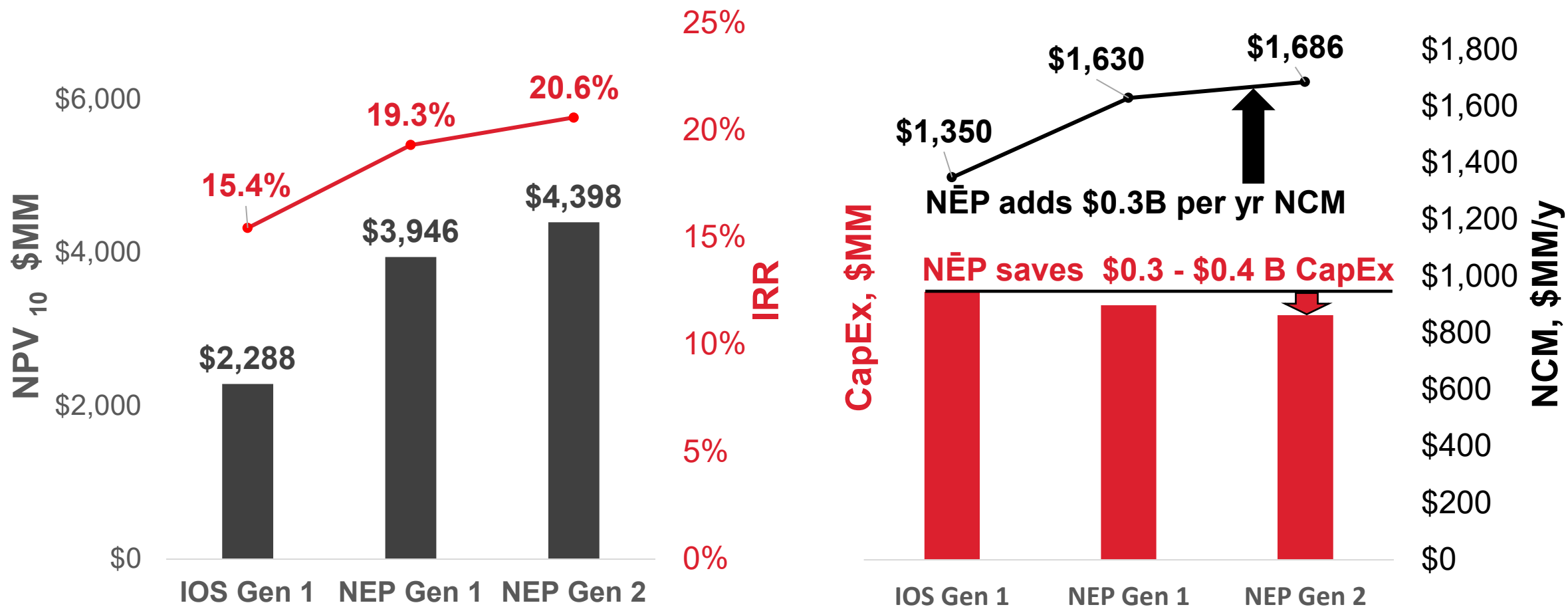
@ SAME ETHYLENE AND PROPYLENE PRODUCTION



NĒP substantially improves economics at constant light olefins

ECONOMICS FOR C2C NĒP VS. GEN 1 IOS

@ +20% ETHYLENE AND PROPYLENE PRODUCTION*



NĒP offers economy of scale advantages for single train ethane crackers

SUSTAINABILITY CREDENTIALS – NĒP

@ SAME ETHYLENE AND PROPYLENE PRODUCTION

	C2C Base	IOS Gen 1	NĒP Gen 1	NĒP Gen 2	Conventional Refiner	
Crude Rate	X	0.70 X	0.68 X	0.65 X	0.65 X	
CO ₂ emissions						
Scope 1, kMTA CO ₂	4,294	4,302	4,168	4,038	968	
Scope 2, kMTA CO ₂	0	0	0	0	234	
Scope 3, kMTA CO ₂	3,851	895	0	0	9,206	
Total kMTA CO₂	8,145	5,197	4,168	4,038	10,409	C2C can reduce CO₂ by 60% vs refining at the same crude rate
Light Olefin, kMTA	2,257	2,326	2,257	2,257	-	
kg CO₂/kg Light Olefin	3.6	2.2	1.9	1.8	-	

WCF 2023

NĒP reduces CO₂ intensity by 50% vs conventional C2C investment

1. C2C base is for a very light light crude HCU config, fully integrated with steam cracker – selling pyoil and pygas into fuels markets – no on-purpose fuels, which would have higher CO2 footprint

2. Conventional refinery: medium complexity – Coker/FCC based site

3. Scope 3 estimates are for products that are burned as fuels and are based on estimates of their carbon content

Honeywell Confidential - ©2023 by Honeywell International Inc. All rights reserved.

CONCLUSIONS

1

Different feedstocks want to be specific products. Leverage the **Right Feedstocks** for target product objectives.

2

UOP's **Six Efficiencies (E6)** framework drives a progression of change, with a focus on doing more with less while delivering bankability and ESG focused project solutions.

3

Carbon Footprint is having an increased impact on securing investors and access to cash

4

Continued Innovation in equipment, catalyst, process design and control systems all play a part in decarbonizing existing assets.

5

The Integrated Olefins Suite (IOS) enables a **Bankable Solution** to pivot into petrochemicals

Bankable, ESG focused solutions for YOUR Refinery of the Future

THANK YOU

FOLLOW US

Honeywell
UOP

<https://www.uop.com/>



<https://twitter.com/HoneywellUOP>



<https://www.youtube.com/user/Honeywell>



<https://www.linkedin.com/company/uop>



<https://www.accessuop.com/>

Q&A



Keith Couch

Senior Director, Business Development

Honeywell UOP

Keith.Couch@Honeywell.com

Honeywell
UOP