

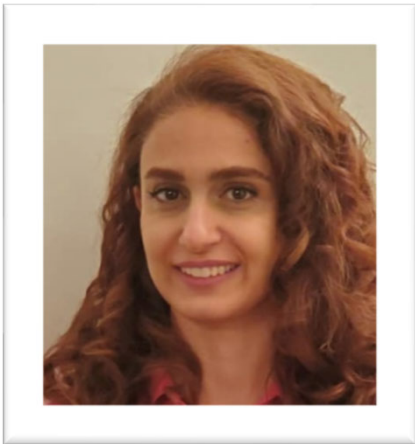


HYDROCARBON PROCESSING®

IRPC

October 2-3, 2024 | DoubleTree by Hilton, Greenway Plaza, Houston, TX

Decarbonizing Olefin Production: Pathways to a Sustainable Future



Ghoncheh Rasouli

Petro-SIM Product Manager



A Yokogawa Company

Petro-SIM®

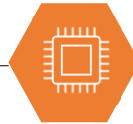
Agenda

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Petrochemical Olefin Market
& Challenges

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Petro-SIM[®] Software Solution

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Conclusion & Q+A



Ethylene Market Growth

Key drivers

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ETHYLENE

6%
Global Market CAGR

Asia-Pacific
Dominating Region

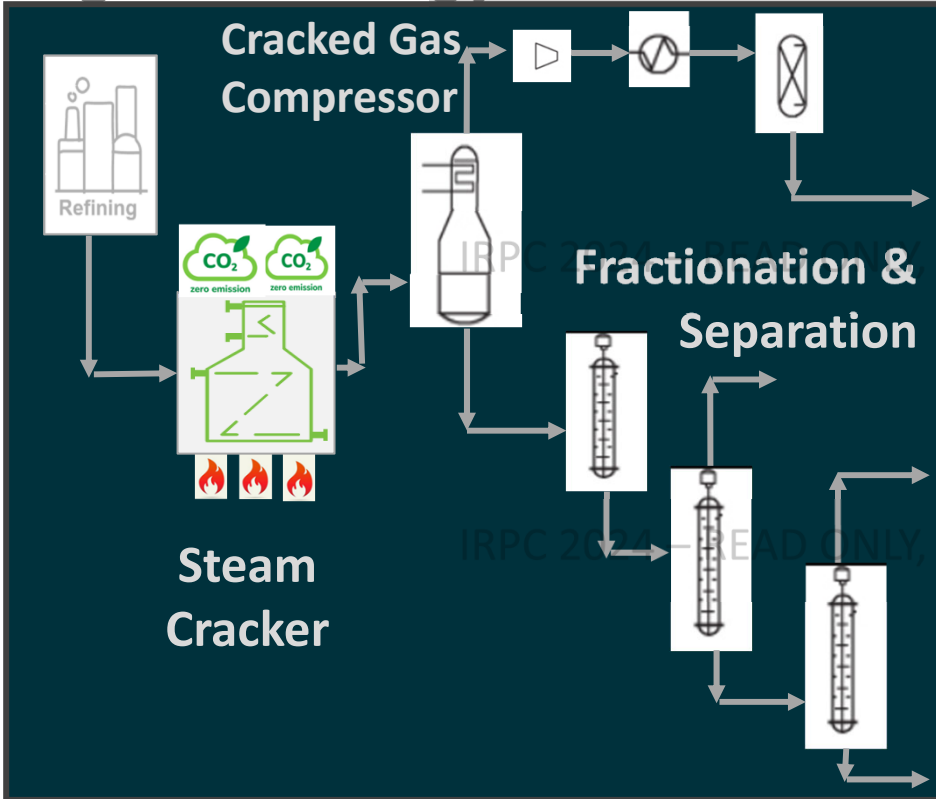
POLYETHYLENE

4%
Global Market CAGR

APAC 17.73
Americas 17.29
million tons in consumption

Sustainable Olefin

Highest energy consumer & emissions producer



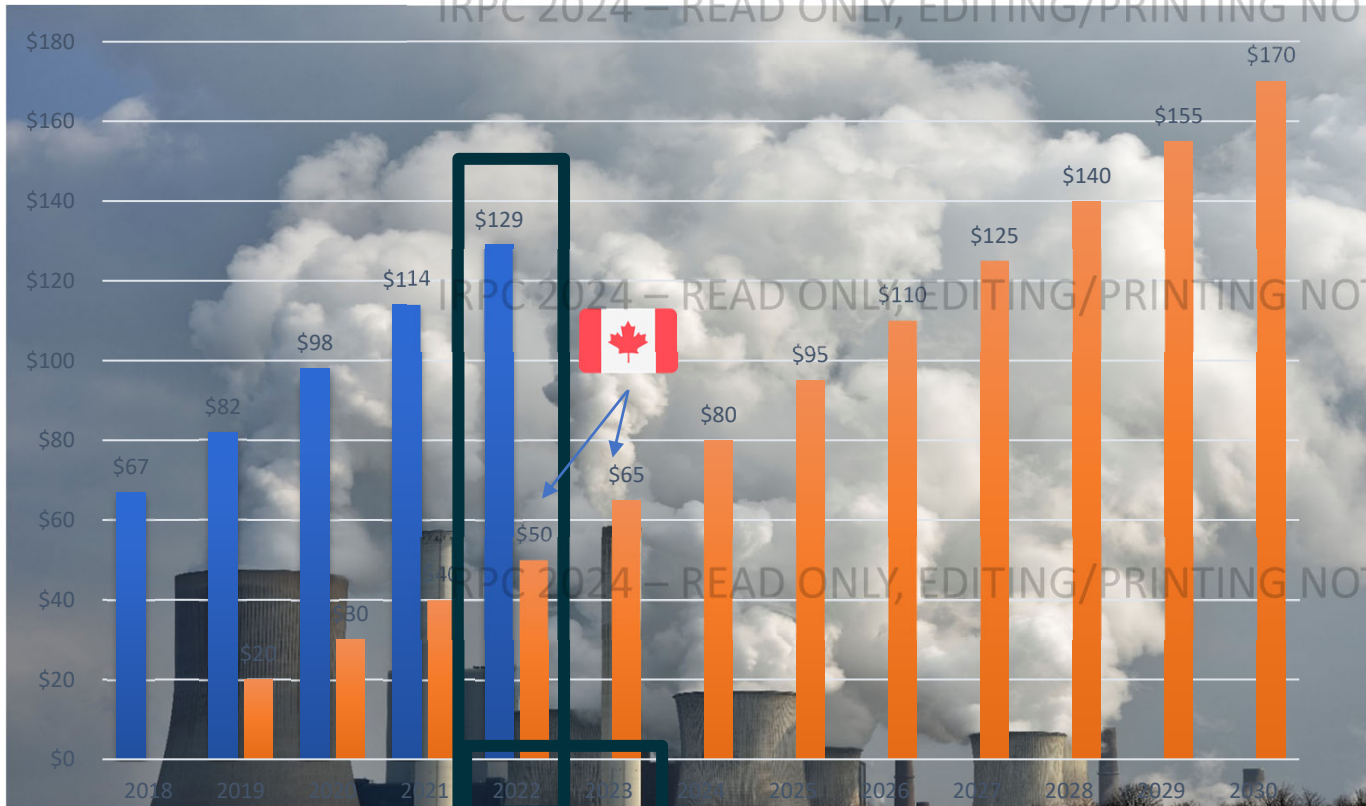
Olefin Industry Challenges

➤ Energy consumption
15 to 27 MJ/ kg_{Ethylene}


➤ CO₂ emission
0.85 to 1.8 MT_{CO2} / MT_{Ethylene}


Carbon Tax Impacts olefin plant operations

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2022

 **FRANCE**
\$129

 **CANADA**
\$50

>250%

[Canada's Carbon Price Will Hit Provincial Gasoline Prices Differently - CleanTechnica](#)

[Dentons - Provinces amend carbon pricing legislation to maintain federal equivalency](#)



Common Challenges



Operations

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Manage operations to maintain quality & planned production



Engineering Design

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Analyze plant performance, in-house projects, designs, & revamp studies



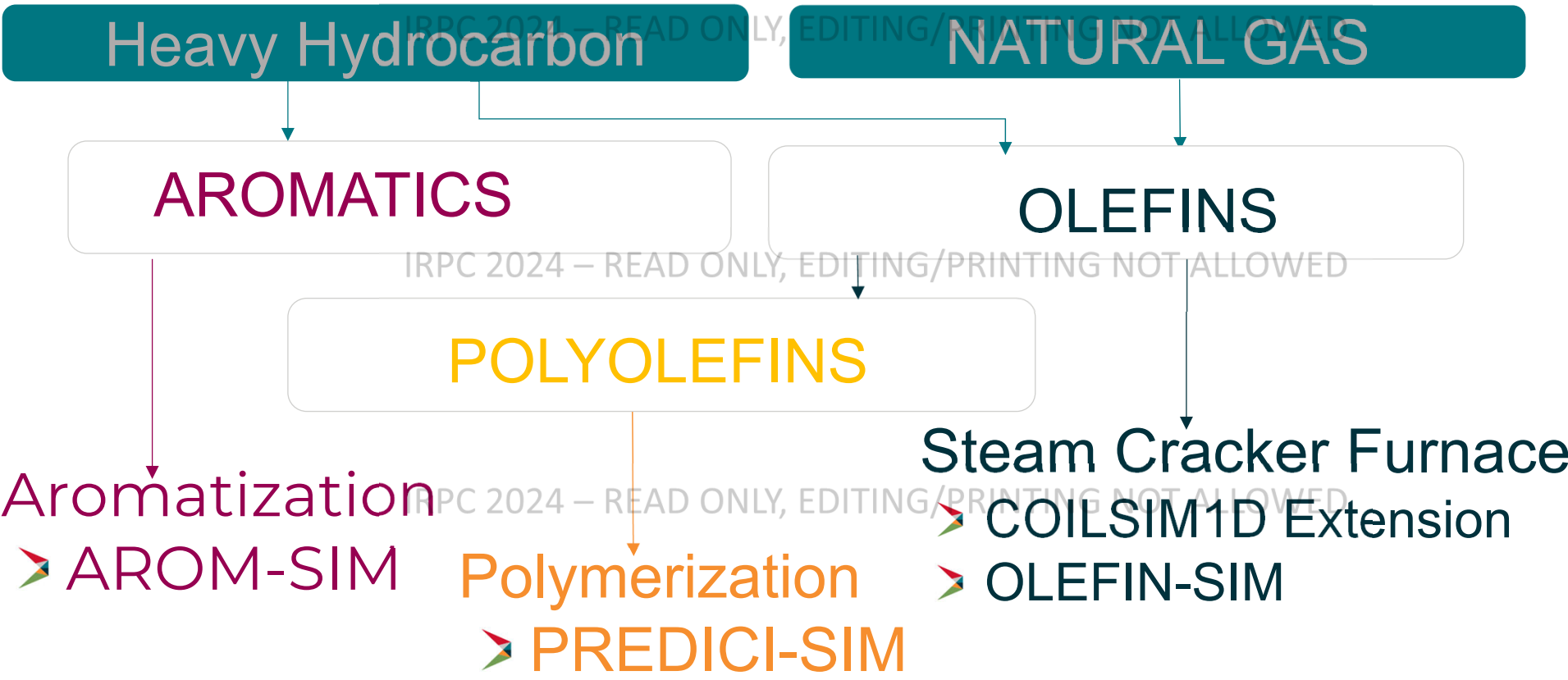
Technologies

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Analyze & implement advanced technologies to optimize operations

A unified platform addressing diverse needs of multidisciplinary teams is essential

Petrochemical Units Challenges



Olefin Plant Process Modeling



Optimization, Decarbonization

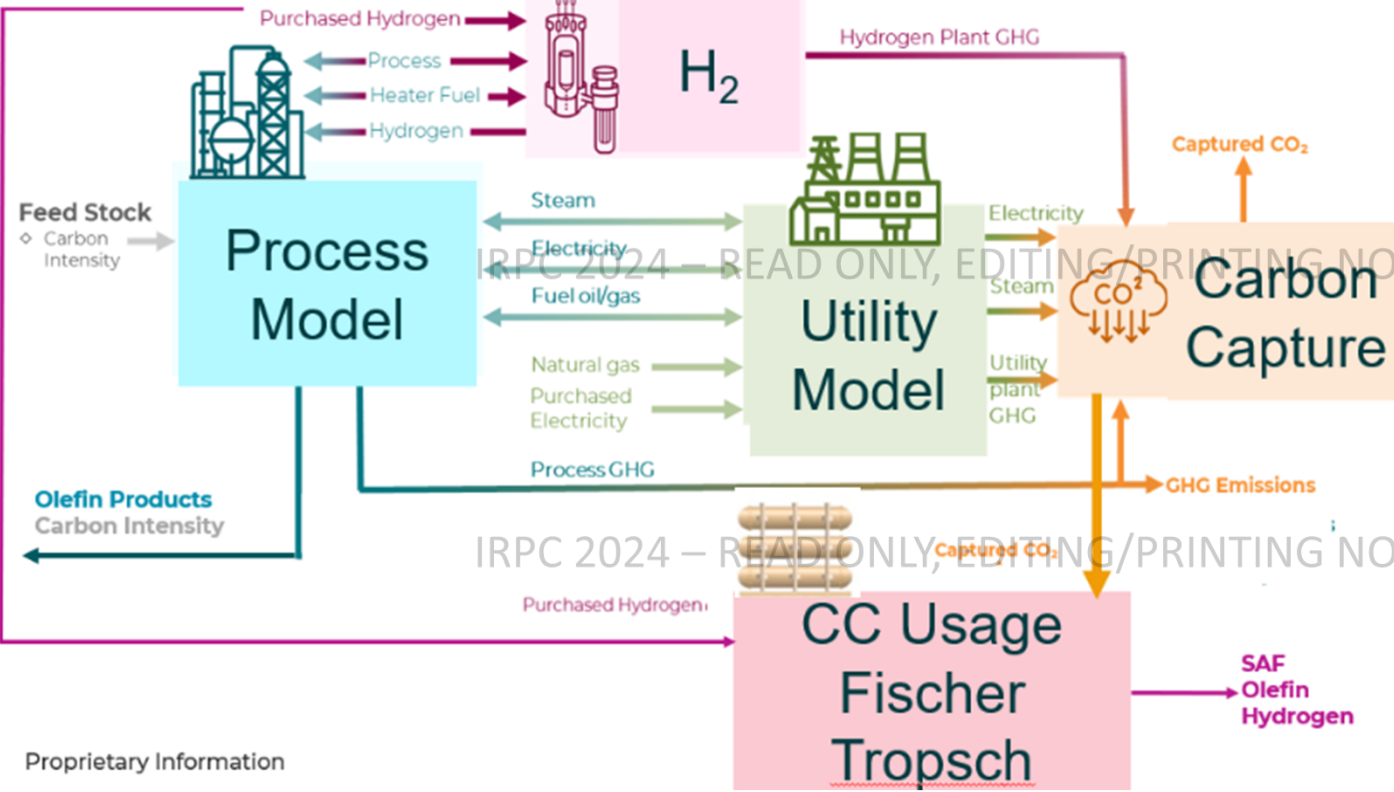
Energy efficiency & Emissions reduction

- Decarbonization strategies
- Minimize energy consumption & emissions, performance & margins
- Performance improvement & Troubleshooting

Independent of Licensor Technology

Bringing It All Together – IP3EM

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Integrated Process, Economics, Energy & Emissions, Petrochemical Wide Model

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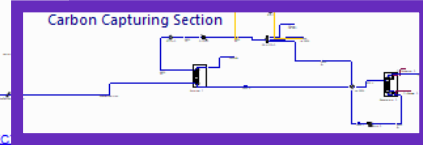
Proprietary Information

Olefin Plant-Wide Model

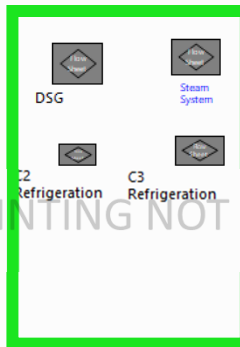
IP3EM main parts

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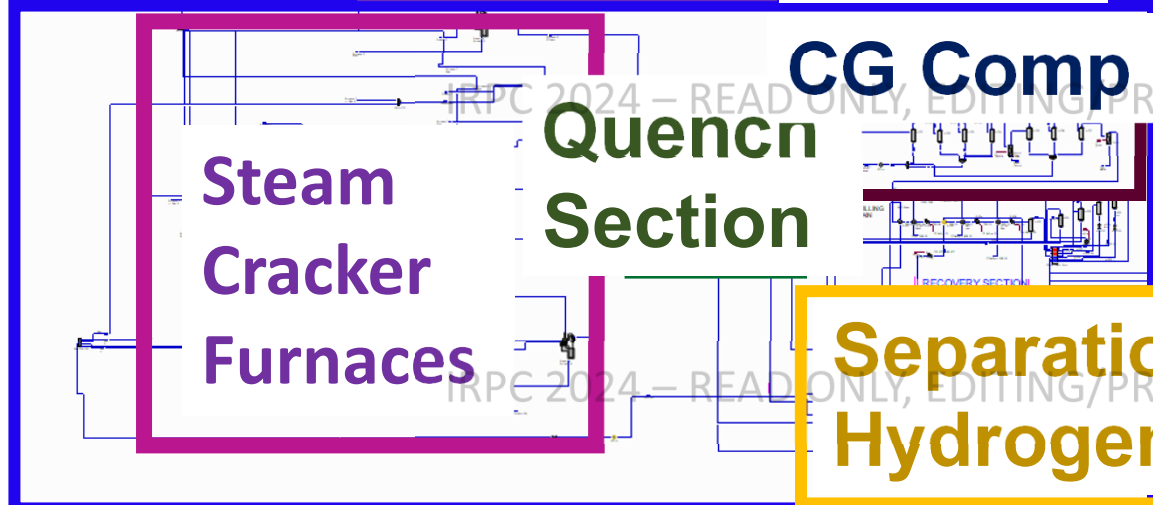
Process side



Carbon Capture



Utility side



Steam Cracker
Furnaces

Quench Section

CG Comp

Separation & Hydrogenation

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Feeds, Product, utilities, COST	Furnace Fuel	SHP Steam & Steam Generation	Dilution Steam	Furnace Operation Panel	CO2 Emission and Carbon Intensity	Total Fuel & Energy Consumption in Cracker and CGC	BT Calculation-Needs to be completed	FeedCostProductSaleMargi
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Decarbonize Olefin Plant

→ Plant Optimization & Energy Efficiency

→ Steam Cracker Decarbonization

EMISSION REDUCTION STRATEGIES

- ✓ Coil Configuration/ GT
- ✓ Refractory Emissivity
- ✓ Combustion Improvement
- ✓ Fuel Switching

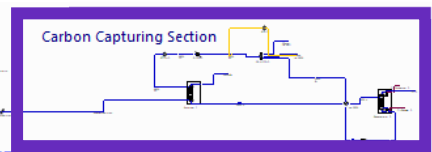
ZERO EMISSIONS

- ✓ CCU: Fischer Tropsch, Methanol to Olefin
- ✓ Fuel to H₂

Olefin Plant Decarbonization Strategies

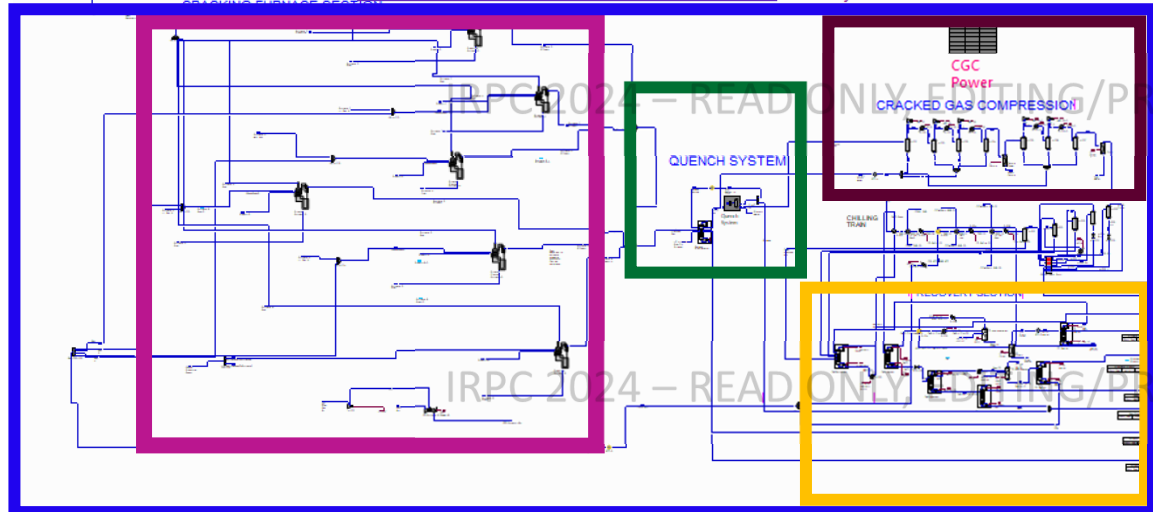
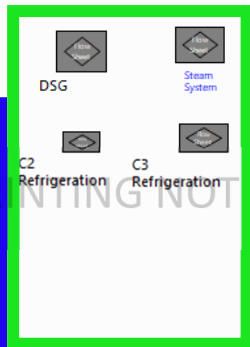
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Process side



CO2 Removal Efficiency

Utility side



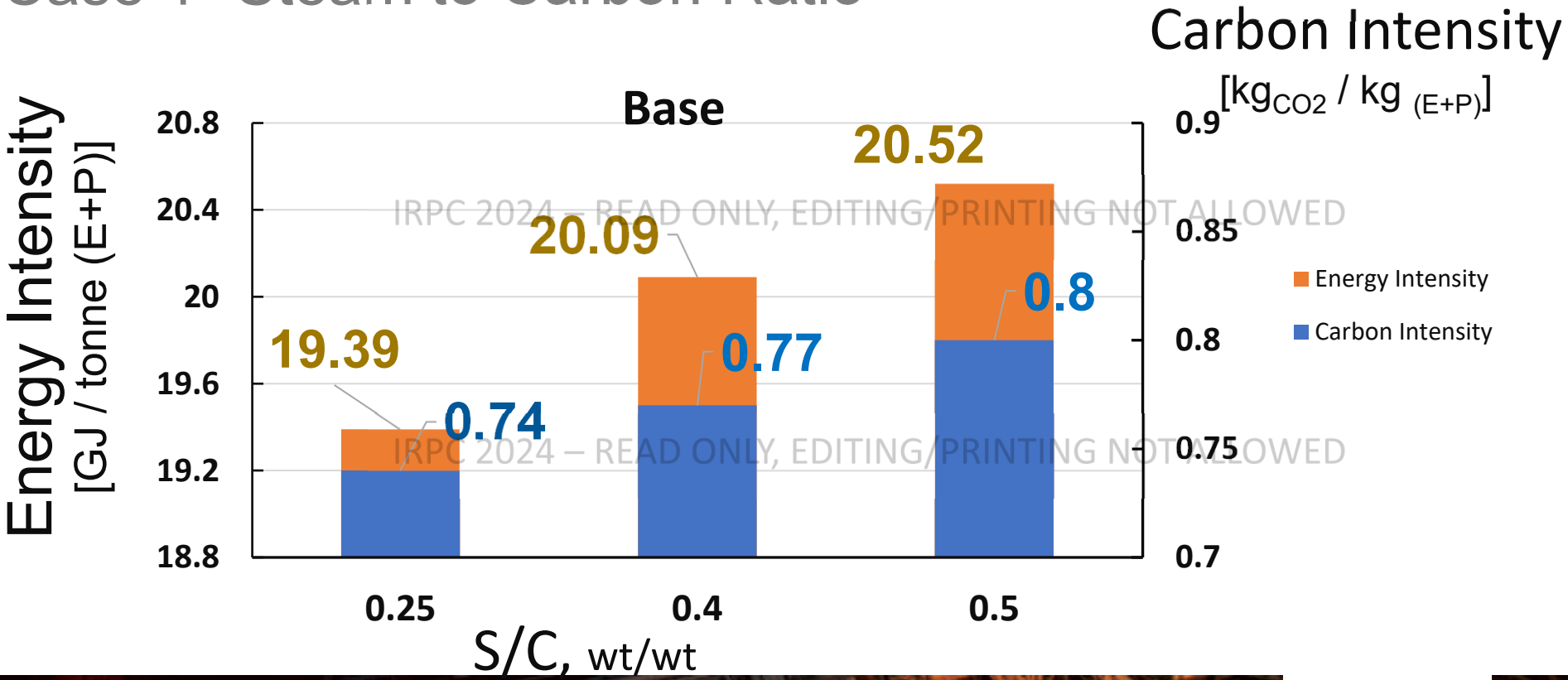
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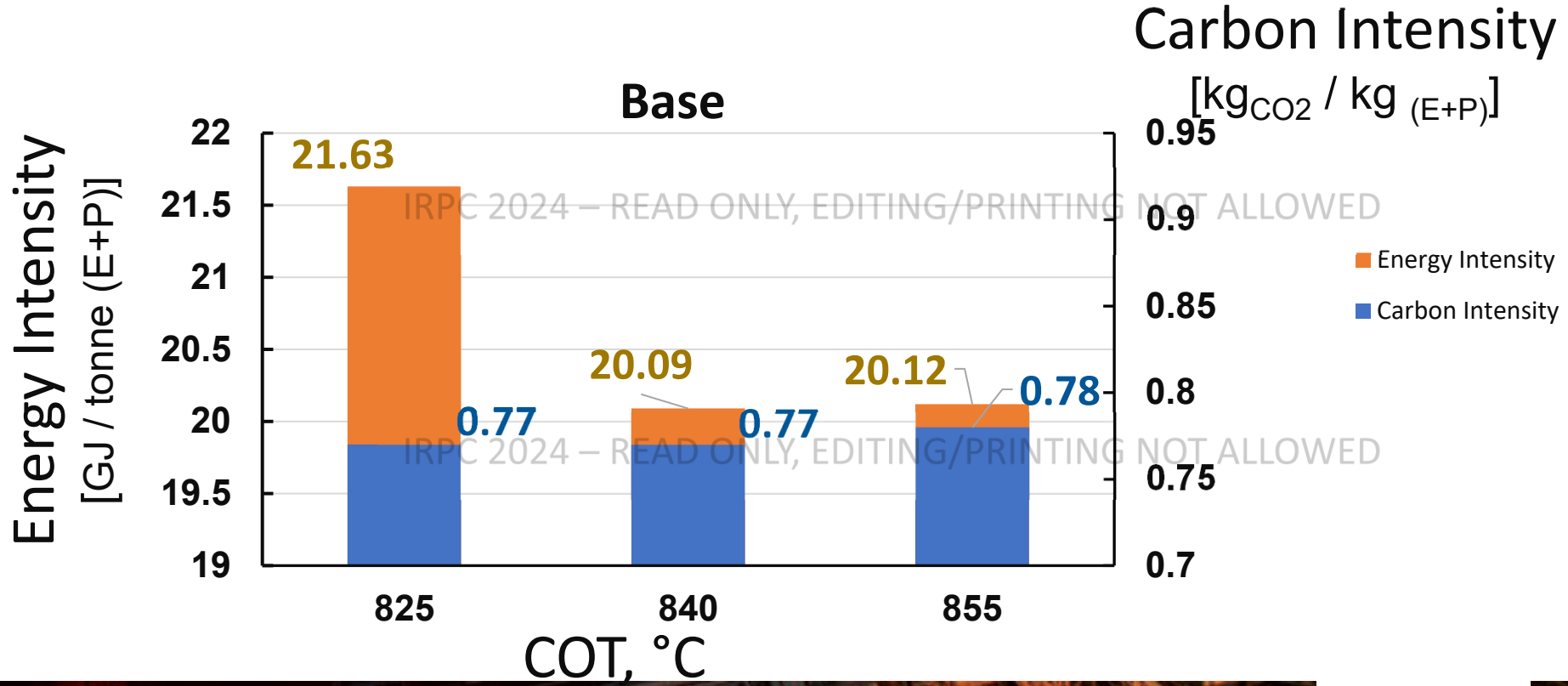
Olefin Plant Decarbonization (Light Gas Feed)

Case 1- Steam to Carbon Ratio



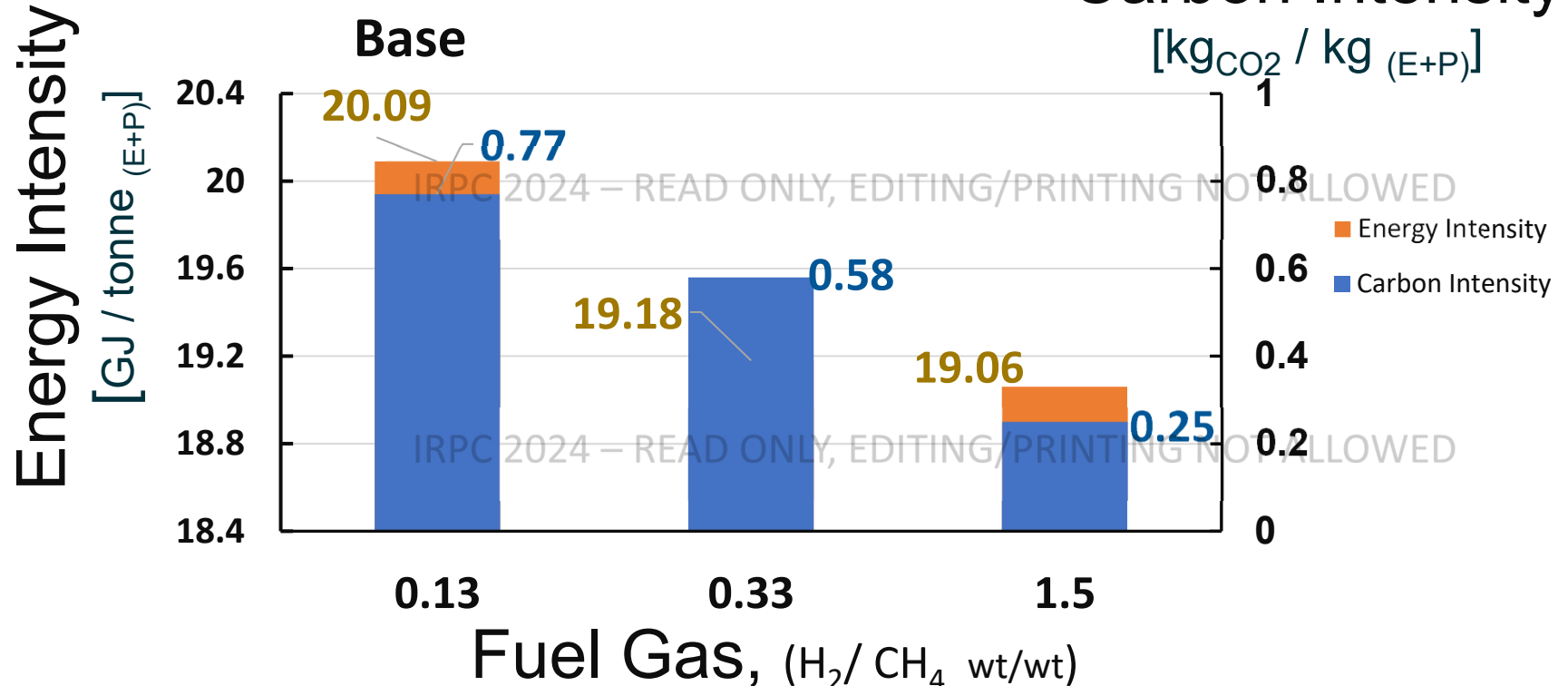
Olefin Plant Decarbonization (Light Gas Feed)

Case 2- Coil Outlet Temperature



Olefin Plant Decarbonization (Light Gas Feed)

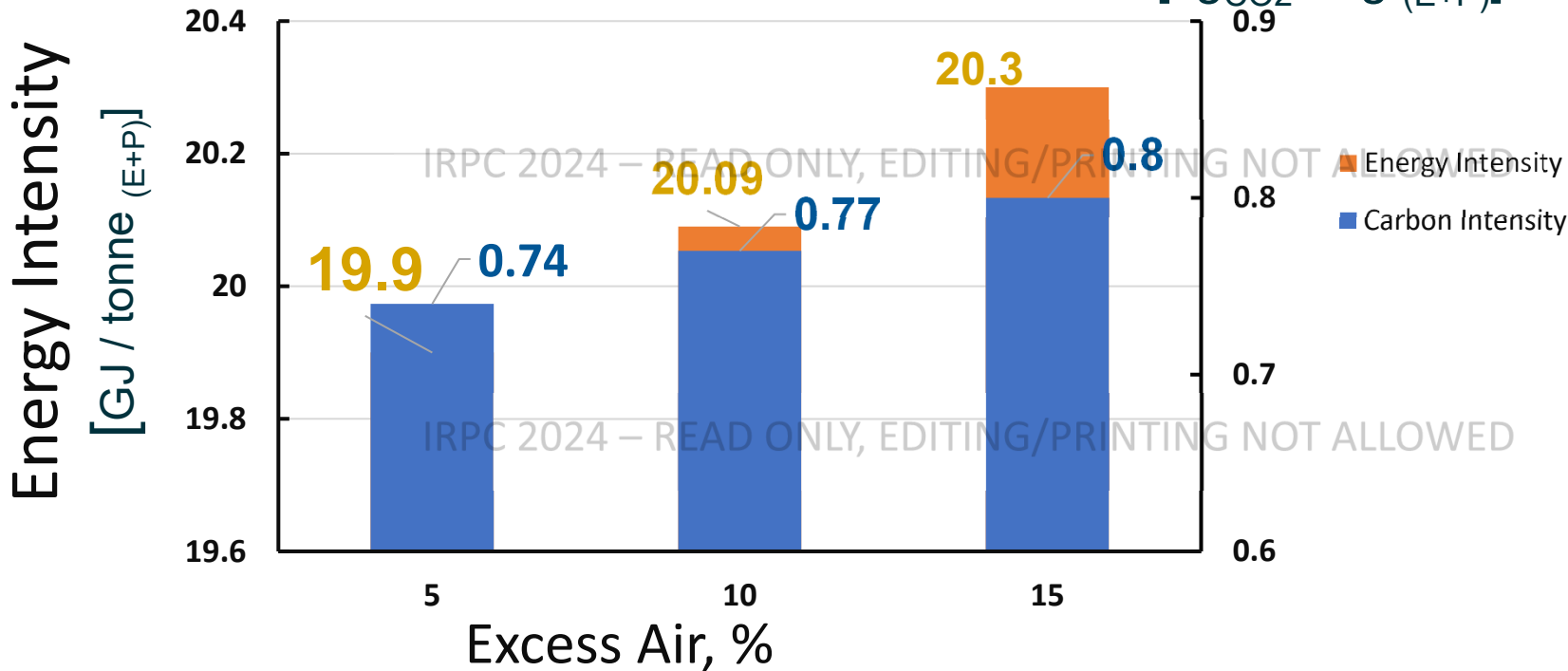
Case 3- H₂ Rich Fuel Gas



Olefin Plant Decarbonization (Light Gas Feed)

Case 4- Excess Air

Carbon Intensity



Olefin Plant Decarbonization (Light Gas Feed)

Our findings

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KPIs	Base	Optimized
Ethylene Yield, wt%	38.73	40.54
Severity, P/E	0.254	0.228
Radiation Efficiency, %	36.4	39.28
Stack O2 mol %	1.6	1.15
Carbon Intensity, kg/kg	0.77	0.49
Energy Intensity, GJ / tonne	19.31	18.49

Olefin Plant Decarbonization (Light Gas Feed)

Our findings

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Optimized Conditions

S/C= 0.33 wt, COT= 844 °C, Excess Air = 5%,

H₂ rich FG (H₂/ CH₄ = 0.5 wt/wt)

IMPACT

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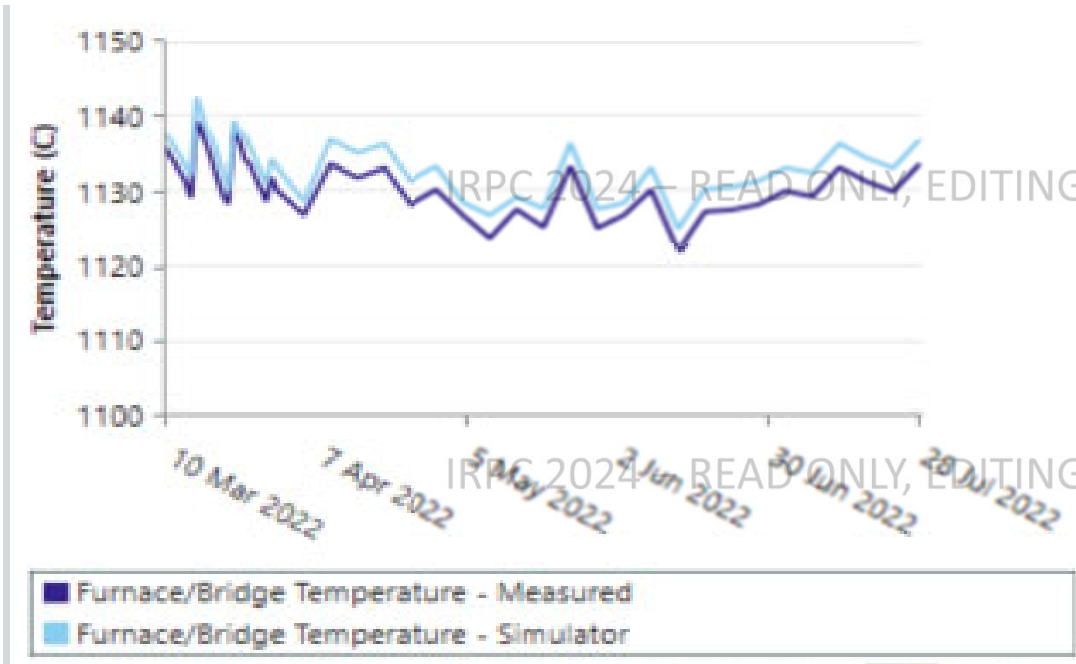
Energy 4.25%↓ Emissions 36.3%↓

Margin 3.72%↑

Steam Cracker Furnace Digital Twin

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Furnace Bridge Wall Temperature



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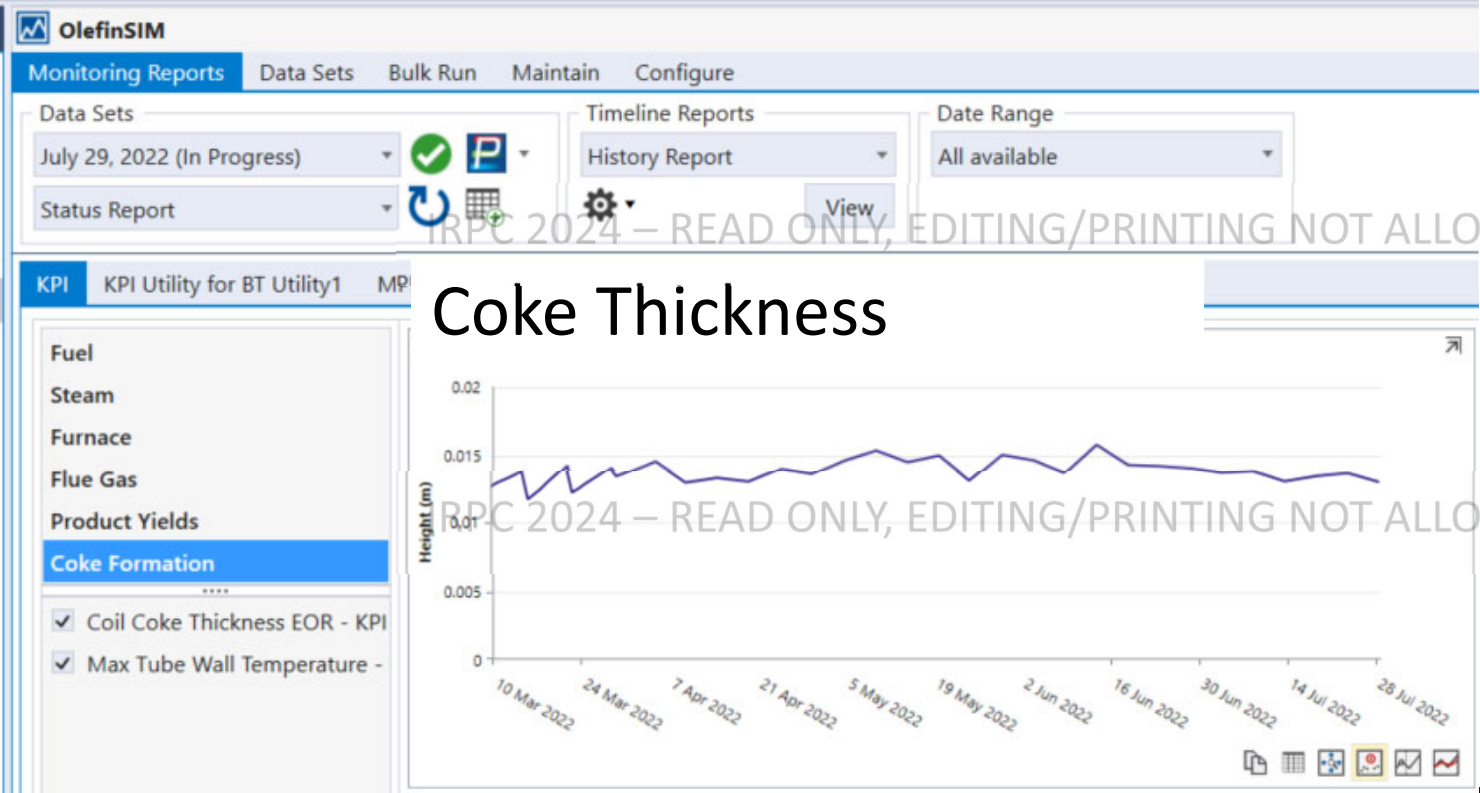
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Steam Cracker Furnace Digital Twin

Example KPI

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Coke Thickness

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A photograph of an industrial refinery or chemical plant at night, featuring numerous tall distillation columns, complex piping, and scaffolding. The scene is illuminated by artificial lights, creating a high-contrast, industrial atmosphere. A semi-transparent red overlay covers the entire image, and a decorative graphic of overlapping curved bands in blue, orange, and red is positioned at the top. The text "Thank you" is centered in the middle of the image in a white, sans-serif font.

Thank you