

Maximize Conversion and Flexibility

The UOP Uniflex™ Process

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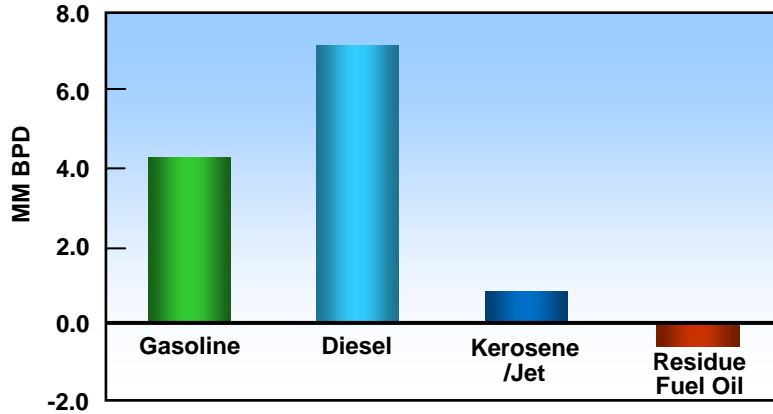
Uop
A Honeywell Company

Maximize Conversion and Flexibility With the UOP Uniflex Process

- **Market Factors**
- **Technology Summary**
- **Capital Savings Through Integration**

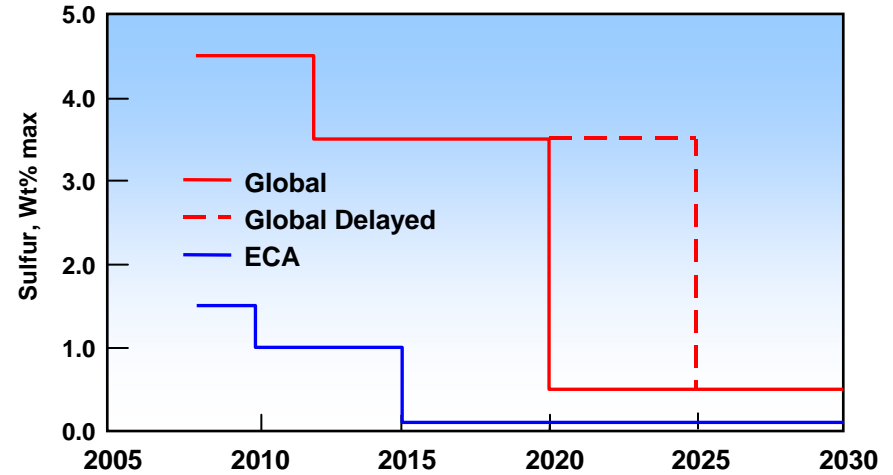
Product Demand, Specifications, and Prices are Changing

Incremental Fuel Demand 2010-2020

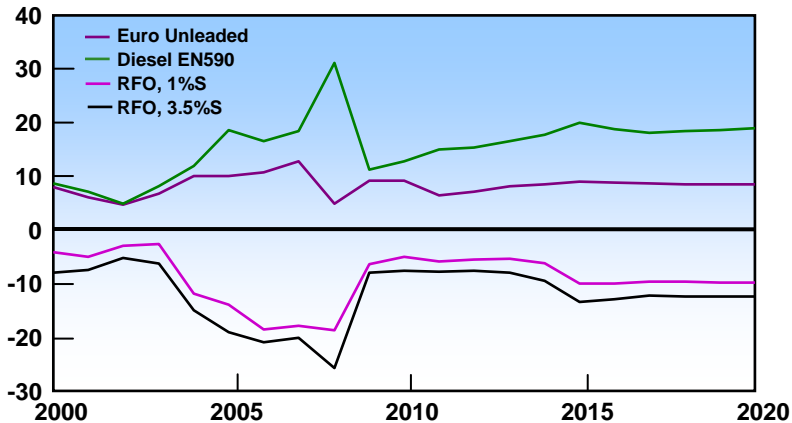


Source: Purvin & Gertz, 2010 GPMO

Bunker Fuel Oil Sulfur Specifications

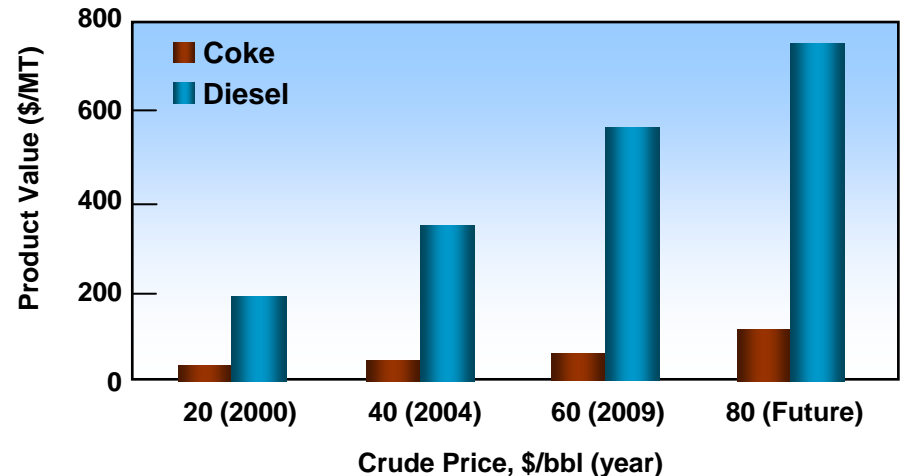


NW European Product Differentials to Brent, Forecast in Constant 2010 \$/Bbl



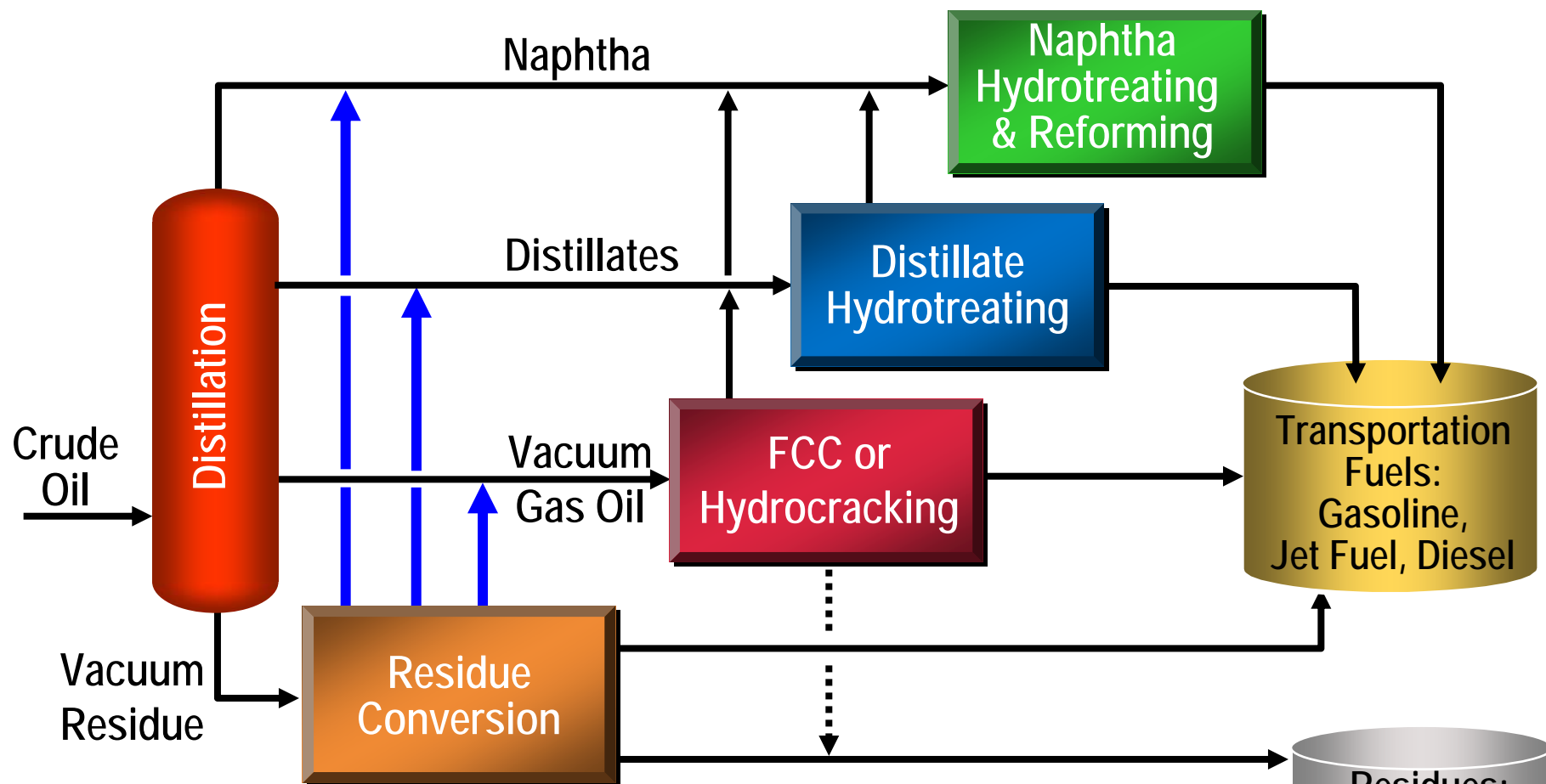
Source: Purvin & Gertz, 2010 GPMO

Diesel Price Premium over Coke



Common goal: Maximize residue conversion to distillates

UOP's Heavy Oil Upgrading Processes



UOP Solutions for Residue Conversion

UOP RCD
Unionfining™
Process

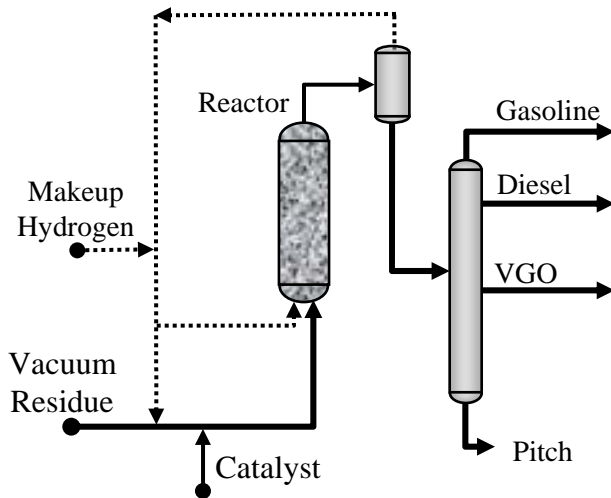
UOP/FWUSA
Solvent
Deasphalting

FWUSA SYDEC™
Delayed Coking
Process

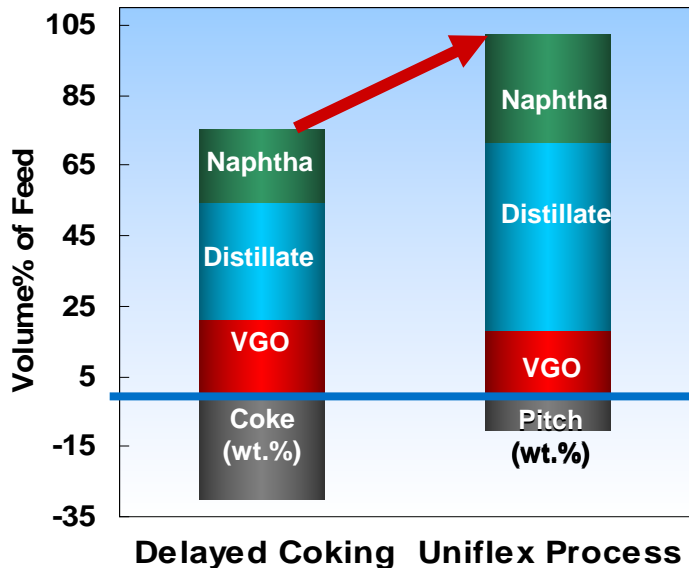
UOP/FWUSA
Visbreaking

UOP UNIFLEX
Process

UOP Uniflex Process



Typical Yields



- **Slurry hydrocracking technology**
- **High conversion to desired products**
- **Contains elements of proven processes**
 - CANMET Hydrocracking Process
 - UOP Unionfining™ and UOP Unicracking™ Processes
- ***Uniflex Process has >25% yield advantage over Delayed Coking***

Uniflex Process

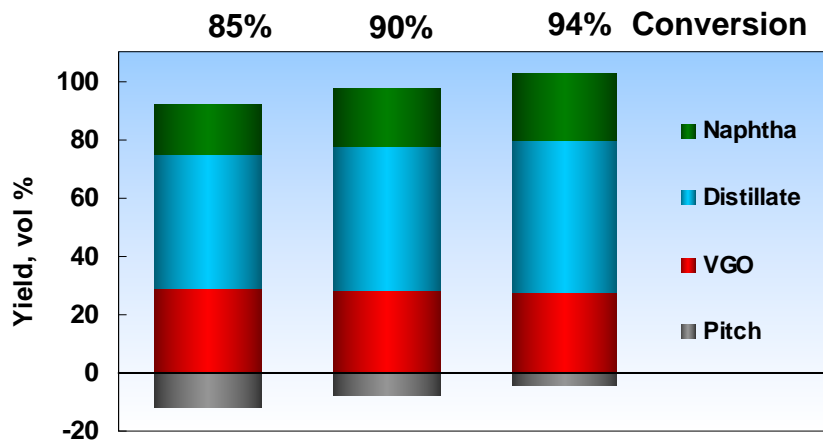
Extensive Commercial Experience

- 25 years R&D
- 15 years commercial operation
- Variety of feedstocks
- High conversion
- 97%+ availability

Petro-Canada Montreal Unit



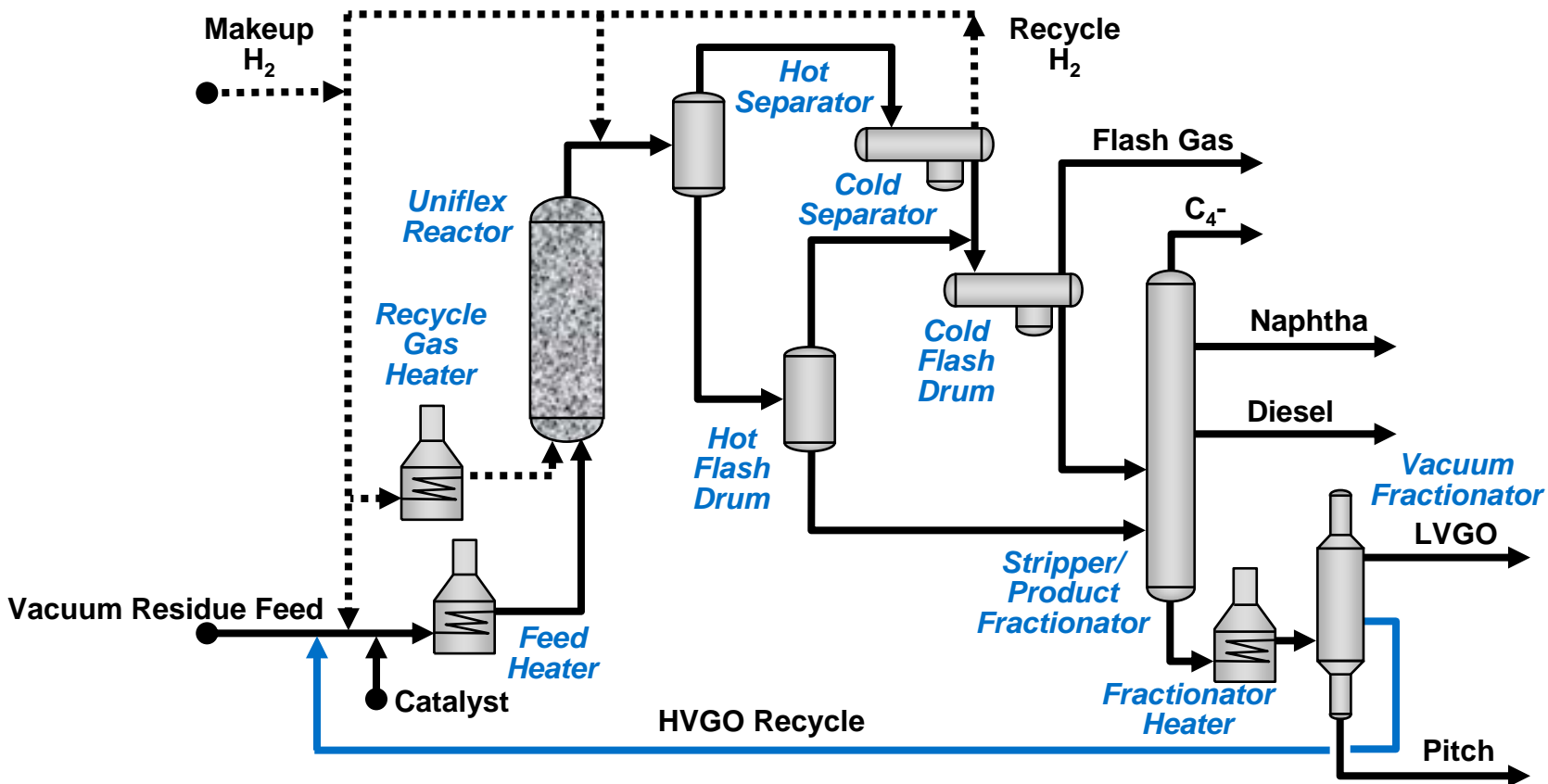
Commercial Performance



Many UOP improvements in the last 5 years

Uniflex Process

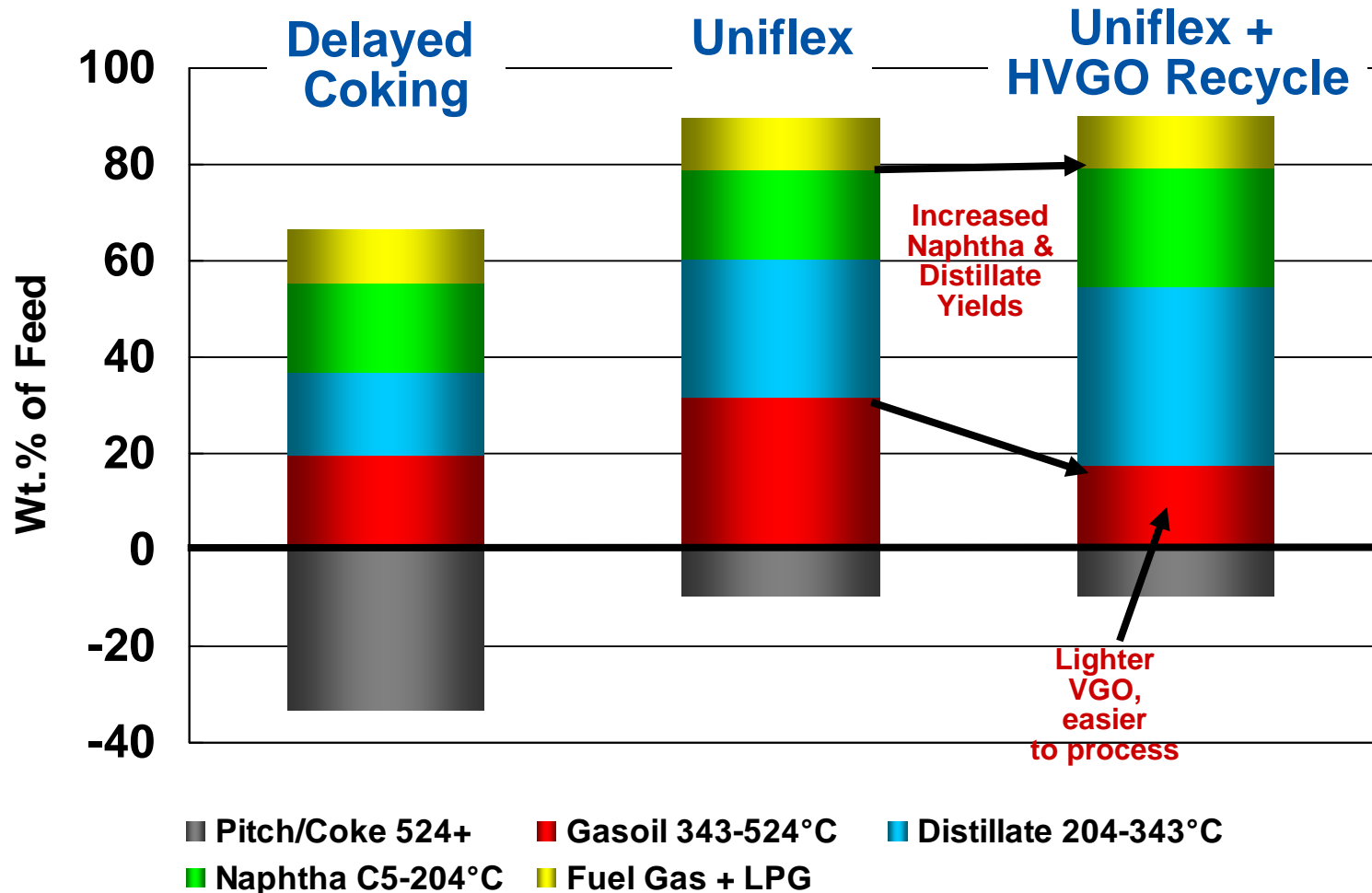
Proven Flowscheme with Improvements



- **Large Unit Capacities**
- **Capital Cost Savings Through Process Integration**

Uniflex Process

HVGO Recycle Improves Yields and Quality

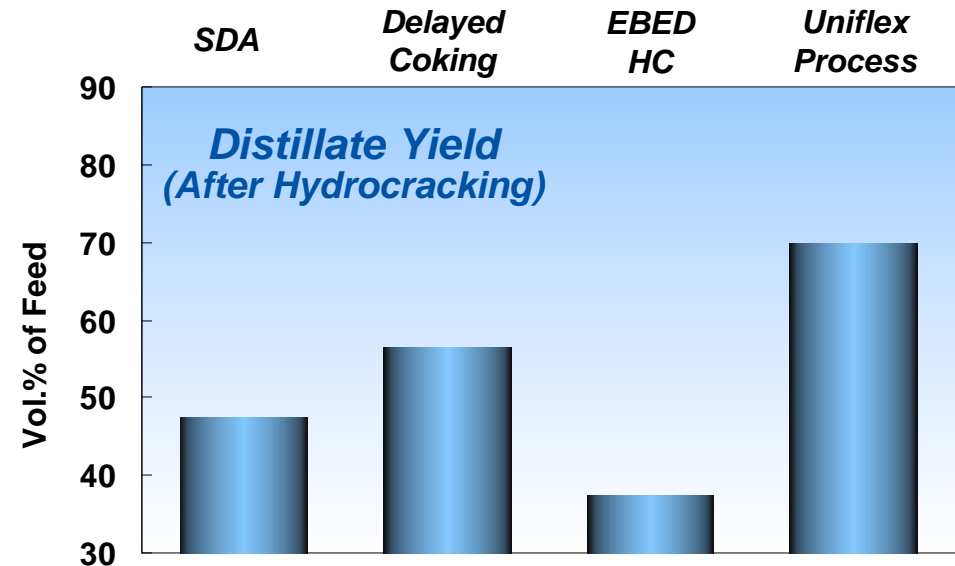
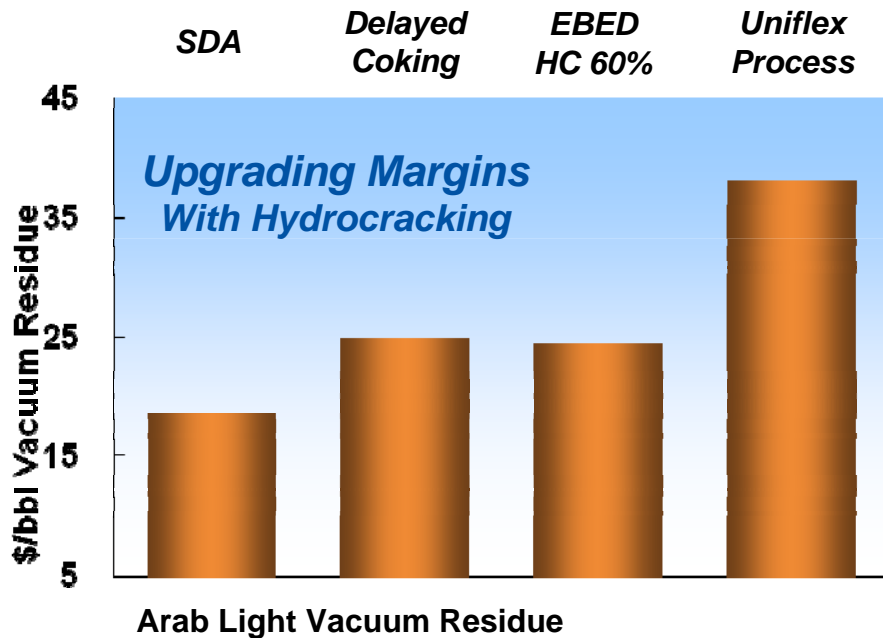
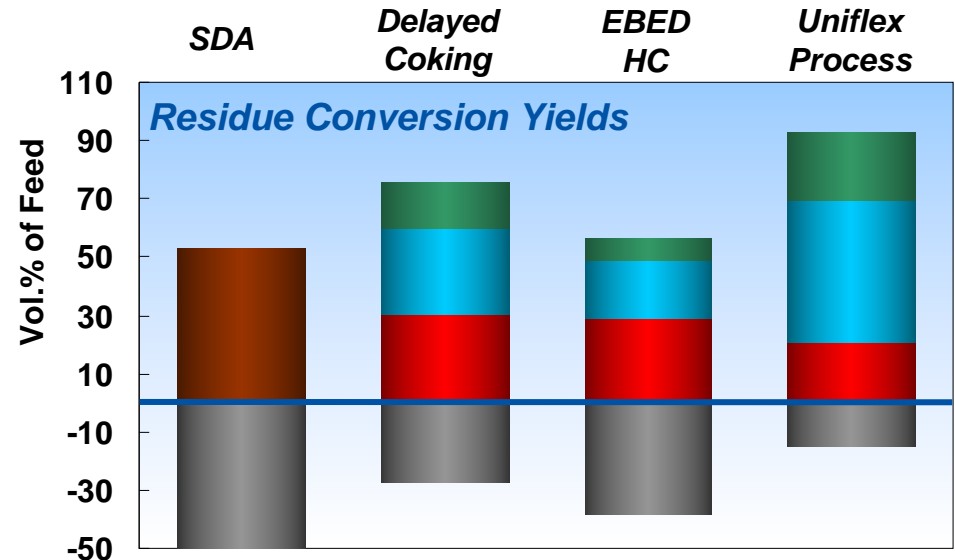


- **Maximum naphtha and diesel yield from vacuum residue**
- **VGO conversion without a separate Mild Hydrocracking Unit**

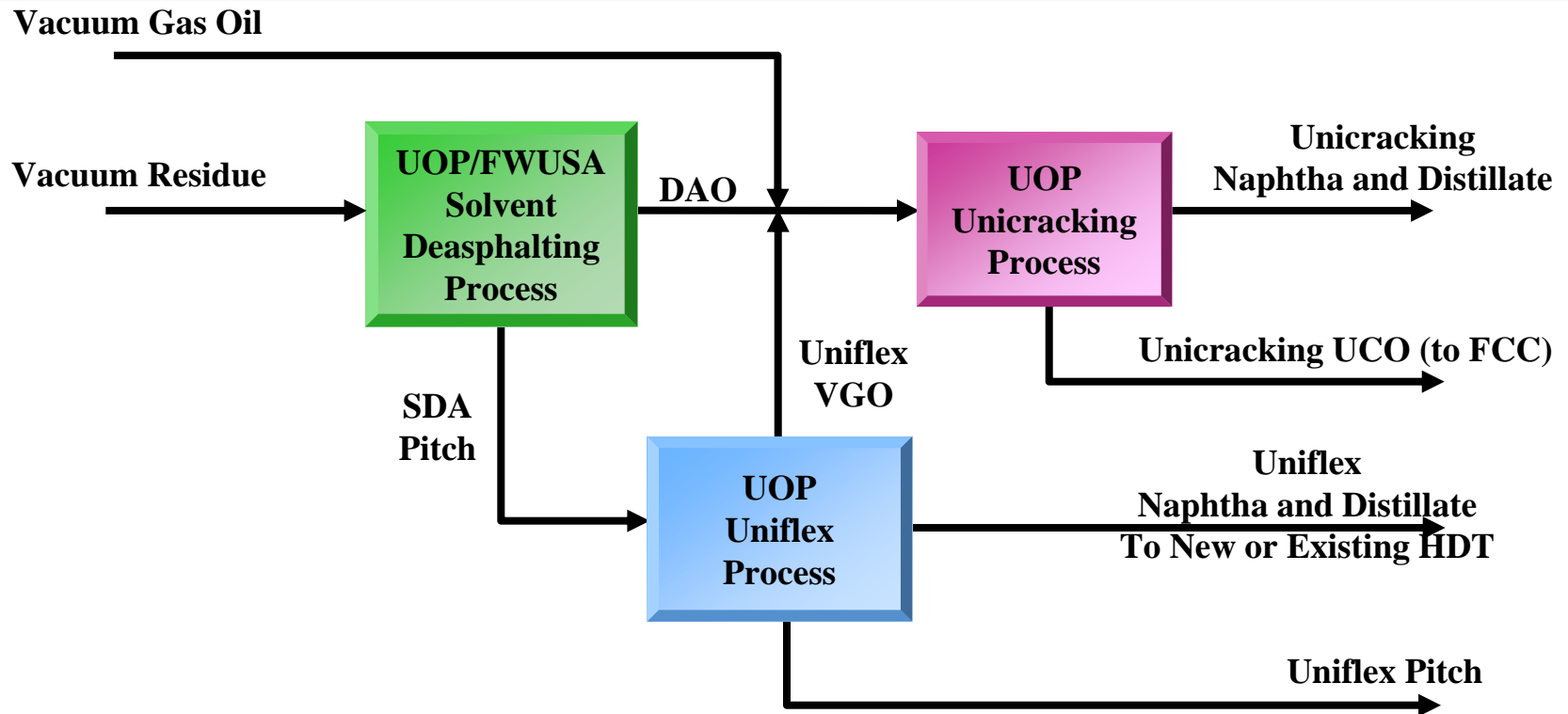
Base Case: Uniflex Process Compared to Other VR Conversion Processes

Uniflex Process Benefits:

- High liquid yields on vacuum residue feed, especially distillates
- Minimum residue by-products
- Significantly increases margins



Uniflex Process Integrated with UOP/FW Solvent Deasphalting & Unicracking Process

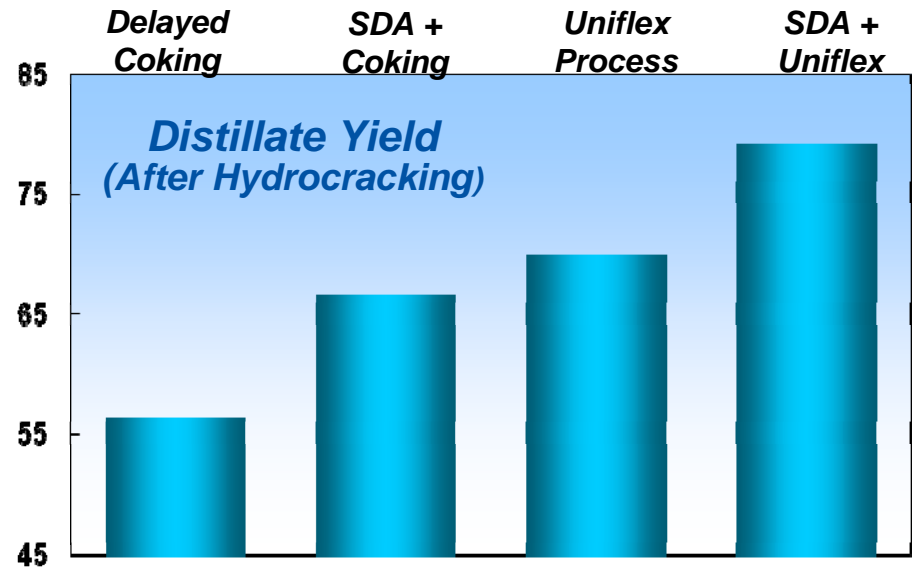
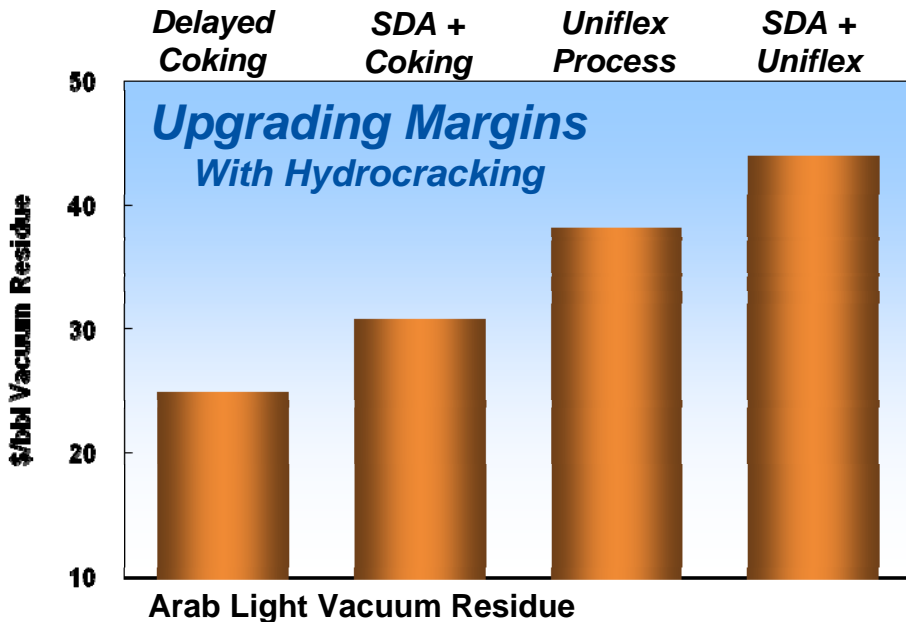
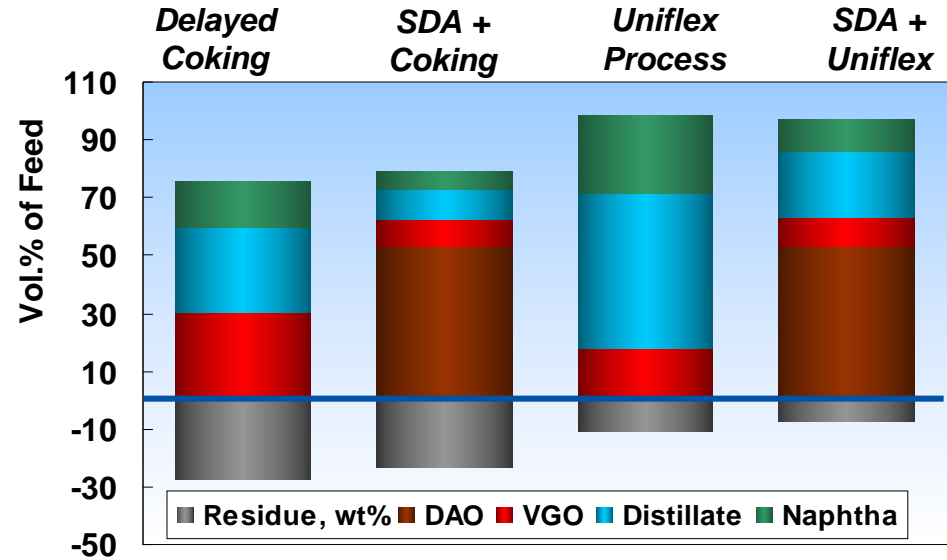


- **Maximum Distillate Production**
 - 95% Vacuum Residue Conversion with Uniflex and SDA
 - 99+% VGO conversion with Unicracking Process
- **Low Capital Cost Upgrading Complex**
 - Low capital cost SDA
 - Small, moderate reactor pressure Uniflex Process Unit

Integrated Case: Solvent Deasphalting/Uniflex/Unicracking Processes

SDA/Uniflex/Unicracking Benefits:

- Very high vacuum residue conversion
- Maximum distillate yields on vacuum residue feed
- Highest margins
- Capital cost reduced
- Increased operating flexibility



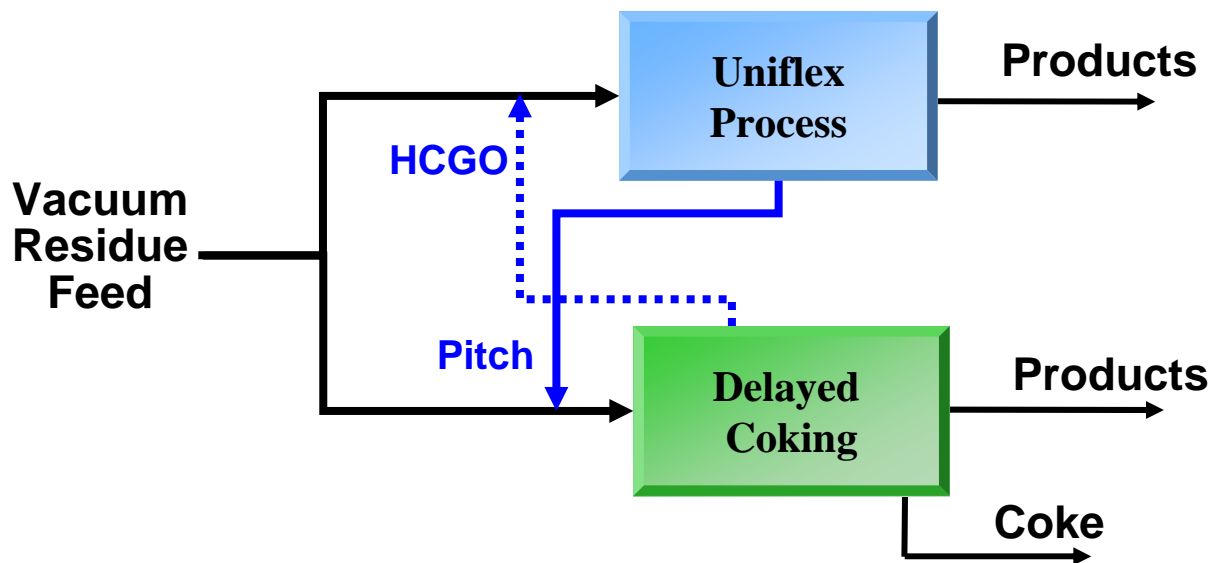
- **UOP/FWUSA Combined Experience**
 - Over 70 units licensed (500 to 50000 BPD)
 - Proven scale-up between pilot plant and commercial operations
- **Recent Selection in 6 Projects**
 - All units won in competitive bidding
 - Utilizing features from both UOP and FW technologies



- **Proven Experience**
 - **>60% of the World's Licensed Hydrocracking Units**
 - **195 Licensed Units in 40 Countries**
 - **>100 Operating Units**
 - **54 Licenses Since 2000**
 - **Experience with all flow scheme options and DAO processing**

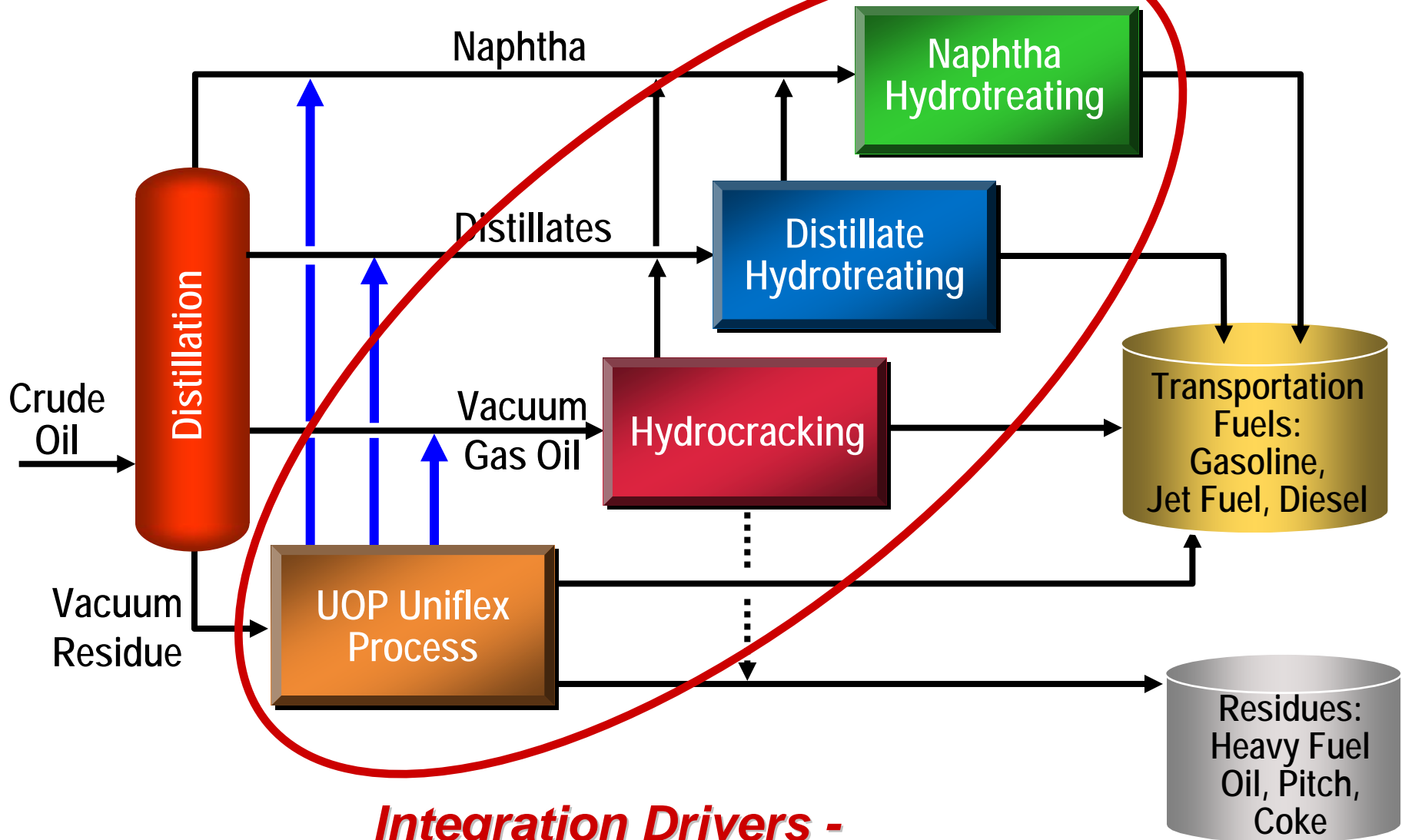
Experience IS the difference

Uniflex Process Integrated with Existing Delayed Coking Unit



- ***Increased Naphtha and Distillate yield***
- ***Heavy Coker Gas Oil converted in Uniflex***
- ***Uniflex Pitch converted in Coker***
- ***Debottleneck Coker and Coker Heavy Gas Oil Hydrotreater***

Integration of Hydroprocessing Units



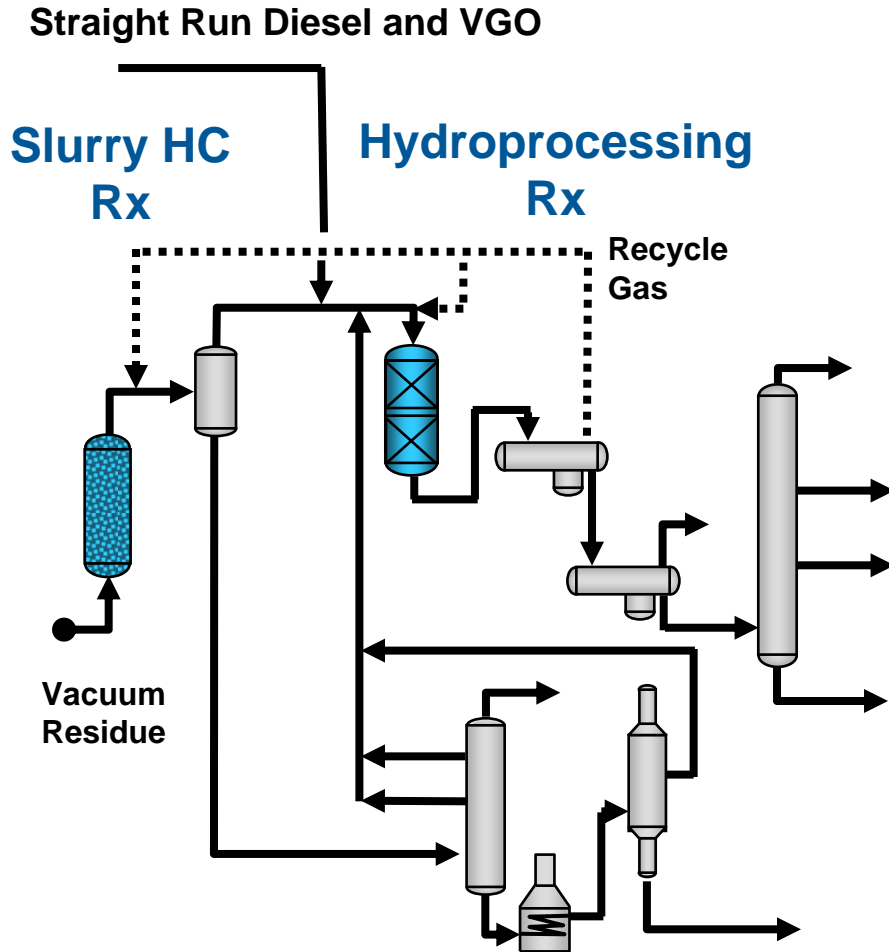
***Integration Drivers -
Capital Cost Reduction and Energy Efficiency***

Slurry Hydrocracking and Hydroprocessing

Issues that impact optimal degree of integration

- **Economics**
 - Capital cost savings
 - Utilities savings
- **Design and operating flexibility**
 - Operating pressures and relative flowrates of units
 - Future changes in crudes and product slate
 - Catalyst performance in HC and HDT
 - Timing of catalyst and inspection turn-arounds
 - Start-up, shut-down, emergency procedures

Full Process Integration Challenges



Features

- Combines slurry hydrocracking and Hydroprocessing in one hydrogen gas loop
- Requires both sour and sweet fractionation systems – products fractionated twice
- Slurry HC and Hydroprocessing sections require same high reactor pressure

Challenges

- Moderate effect on overall capital and operating costs
- H_2S and NH_3 depress catalytic activity and selectivity
- Diesel yield loss via cracking

Selective Integration Benefits

- **UOP offers many integration options to meet refiners varied requirements**
- **Examples**
 - **Common H₂ recovery and compression systems for make-up gas and off-gas**
 - **Parallel recycle gas systems**
 - **Uniflex products integrated directly to UOP Unicracking and UOP Distillate Unionfining**
- **Benefits**
 - **>10% capital savings for Uniflex, Unicracking, Distillate Unionfining Heavy Oils Complex**
 - **Performance optimized of each unit**
 - **Reduced contamination in catalytic process units**
 - **Unicracking: >99% VGO conversion**
 - **Distillate Unionfining - Maximum diesel yield, quality and cycle length at minimum reactor pressure**

UOP Uniflex Process Will Meet Your Future Transportation Fuel Requirements

- **Ideal Process for Maximizing Transportation Fuels from Vacuum Residue**
- **Unique Solutions for Maximizing Distillate**
- **Extensive Commercial Operations Background**
- **UOP Development Program Assures Future Units Success**
- **Optimization and Integration Solutions will Maximize Benefits for your Refinery**



Q & A