

FCC UNIT FEEDSTOCK FLEXIBILITY IN MOL'S DANUBE REFINERY

Tamás Kasza PhD – Head of Technology Development
Tamás Németh – Process Technology MOL

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AGENDA

1

INTRUDUCING DANUBE REFINERY

2

DCU light naphtha processing in FCCU

3

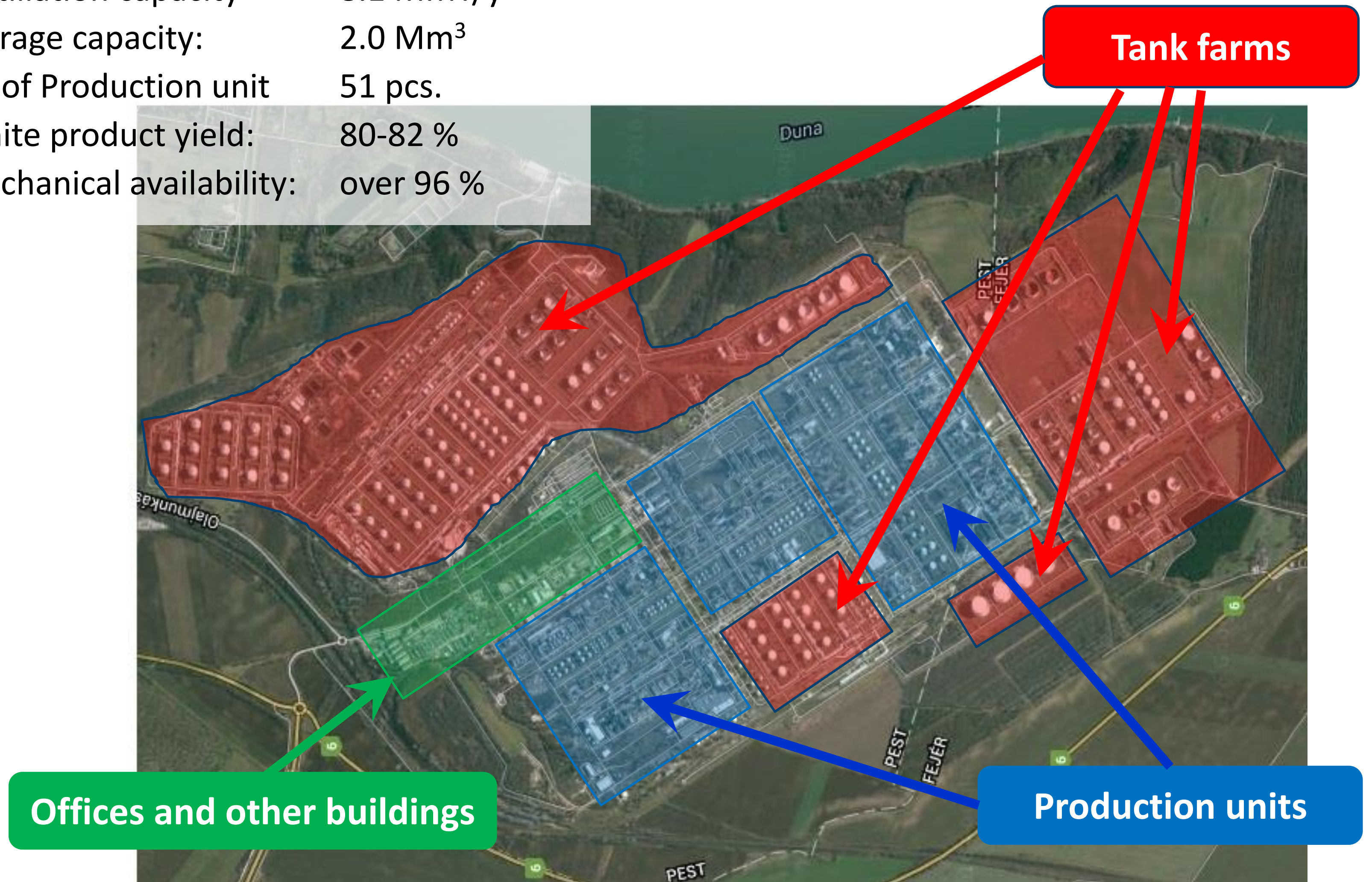
HSVGO processing in FCCU

DANUBE REFINERY



DUNA REFINERY IN NUMBERS

- Distillation capacity 8.1 MMT/y
- Storage capacity: 2.0 Mm³
- Nr. of Production unit 51 pcs.
- White product yield: 80-82 %
- Mechanical availability: over 96 %



CHALLENGES OF DANUBE REFINERY

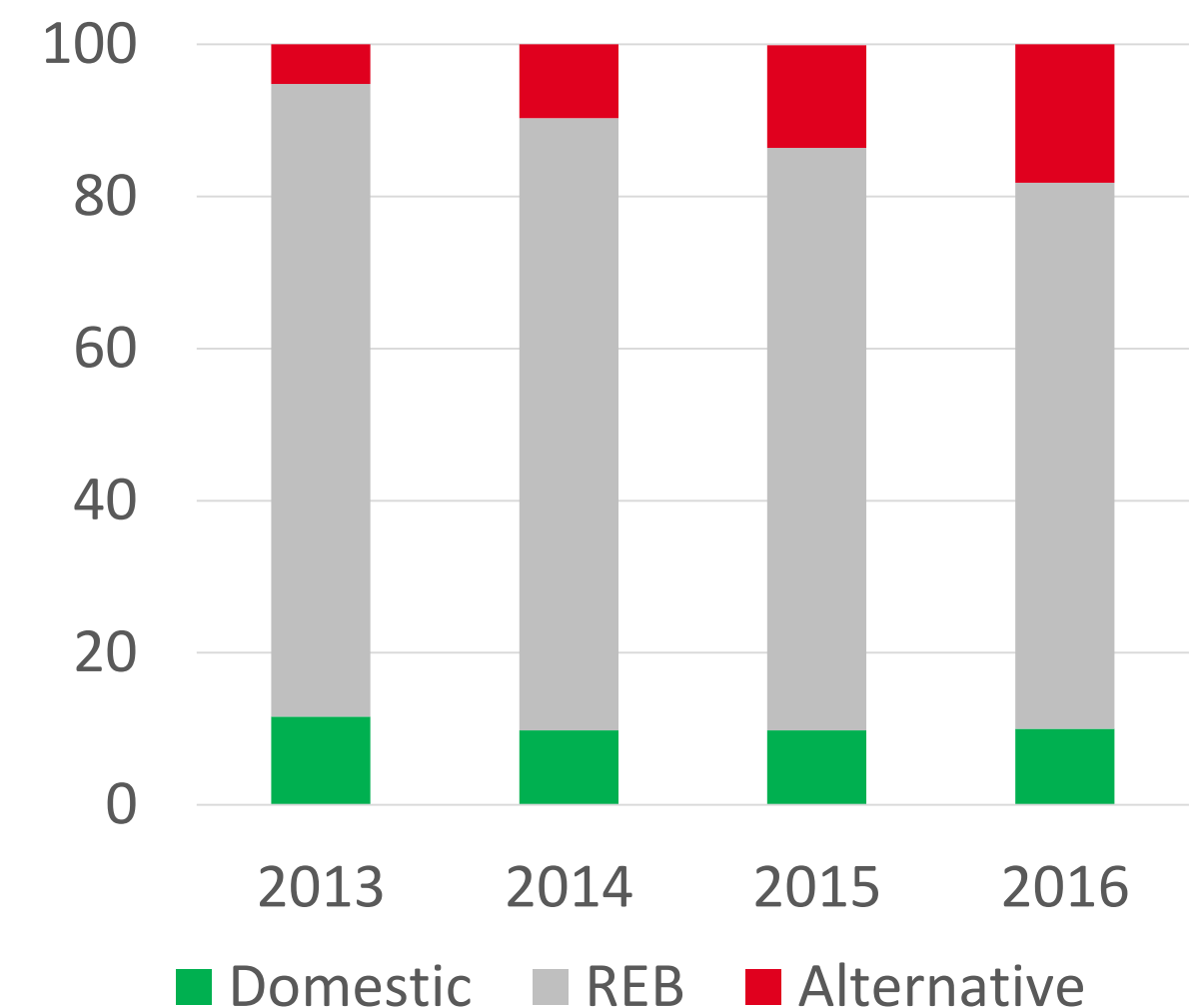
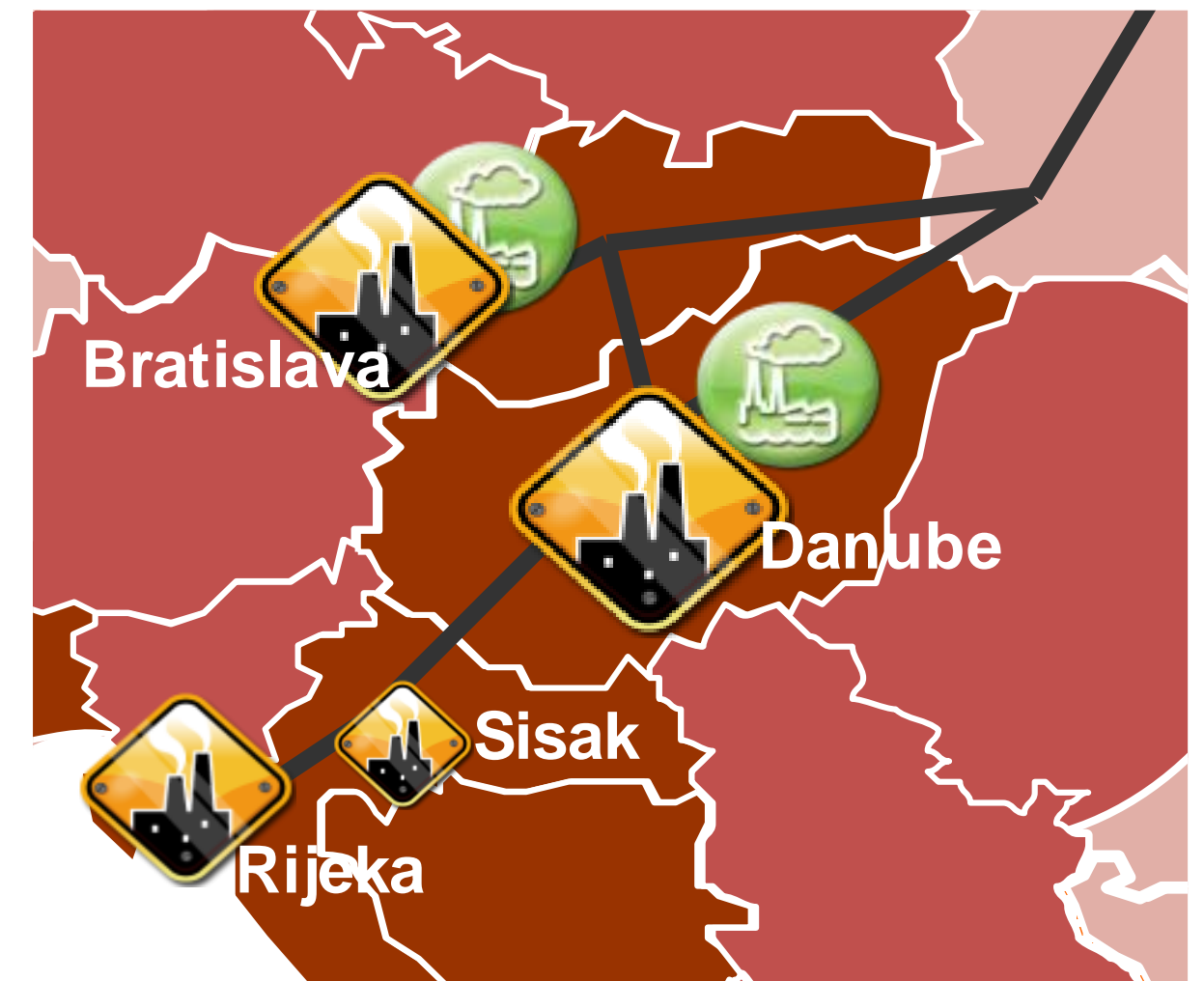
Increasing crude and feedstock variability

- Number and amount of tested crudes is increasing - *Business opportunity to increase more valuable product ratio in our slate and flexibility.*

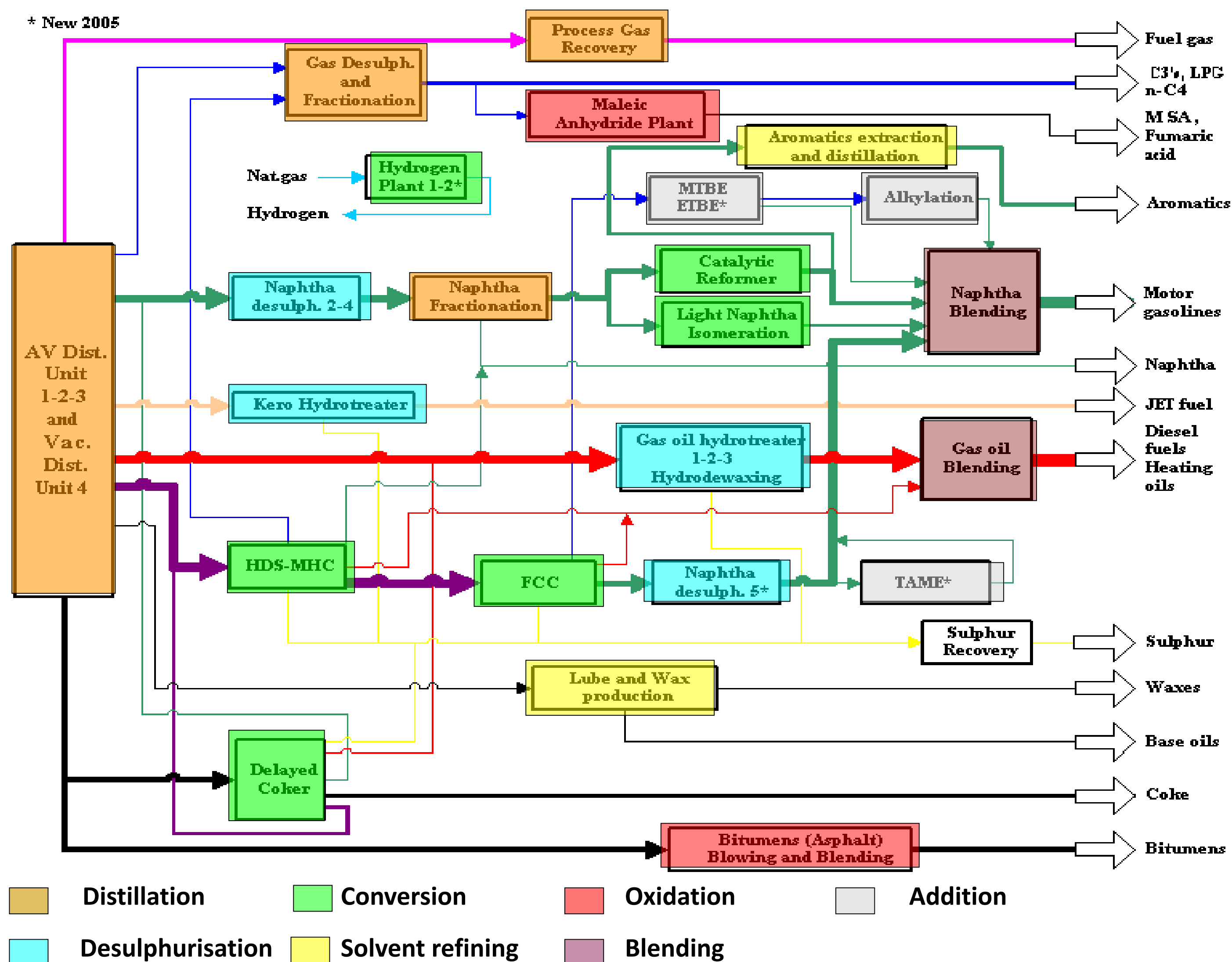
Increase energy efficiency

Tightening environmental and product quality regulations

Maintaining high equipment reliability



FLOWSHEET OF THE DANUBE REFINERY



MOL DANUBE REFINERY FCC UNIT

UOP FCC (Side By Side) unit

High efficiency regenerator, complete CO combustion

- Feed: Hydrotreated VGO and DC HCGO
- Design capacity: 4000 MTPD
- Design feed sulfur content up to 2%
- **General feed sulphur (2010-2014): 100-400 ppm**

Connected units

- ETBE/selective C4 diolefin hydrogenation unit
- Hydrogen Fluoride Alkylation unit
- FCC Naphtha Hydrotreater
 - Design capacity 2500 MTPD
 - **Design sulfur content is 70 ppm**



DCU LIGHT NAPHTHA PROCESSING

DCU LIGHT NAPHTHA

High sulfur and diene containing light naphtha
Prior processed as chemical naphtha hydrotreatment is a must.

Property	UOM	Value	Specification
Reid vapor pressure	kPa	86.3	
Sulphur content	%	0,19	
C4 olefin content	%(V/V)		max. 8
RON		82	
MON		74	
Bromine number		109	
PONA	%(V/V)	48 / 44 / 7 / 1	
ASTM D86	°C		
IBP		34	
10 %(V/V)		41	
30 %(V/V)		46	
50 %(V/V)		52	
70 %(V/V)		59	
90 %(V/V)		67	
FBP		75	max. 110

DCU LIGHT NAPHTHA PROCESSING

In case of TA of dedicated hydrotreater (NHT-2) unit it can be switched to slop, then reprocessed

Disadvantages:

- Additional processing cost
- Corrosive material
- High olefin in LPG product

Alternative processing is desired e.g. processing in FCC

- Sulphur removal partially takes place
- Olefin content is not an issue in LPG product
- Diolefin is partially saturated in ETBE SHU unit
- By cracking of C6 molecules additional propylene is expected

DCU LIGHT NAPHTHA PROCESSING

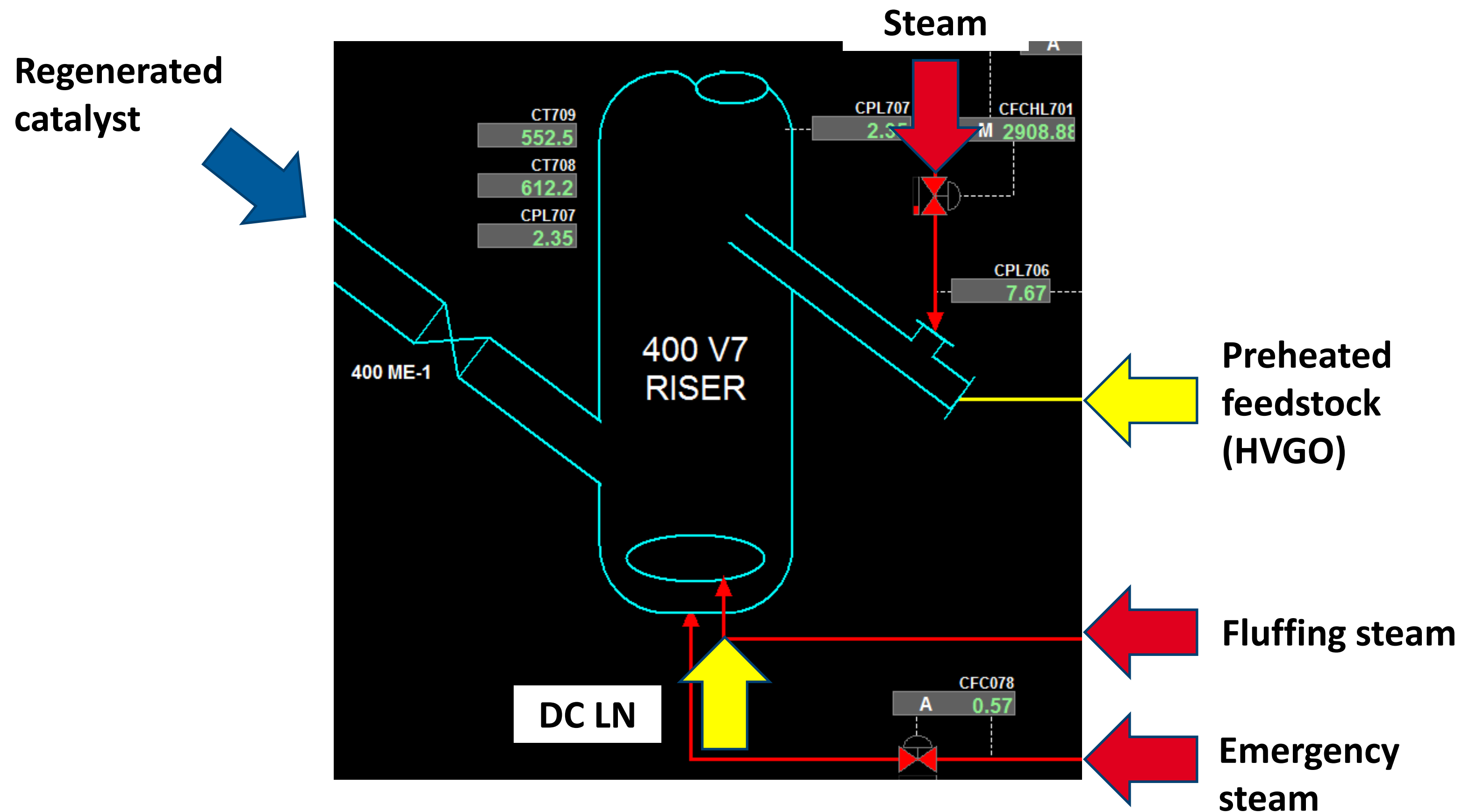
INVESTMENT AND PREPARATION

About 800 m new pipeline was installed:

New flowmeter installation, DCS and interlock system modification

0,15 MEUR

0,07 MEUR



DCU LIGHT NAPHTHA PROCESSING

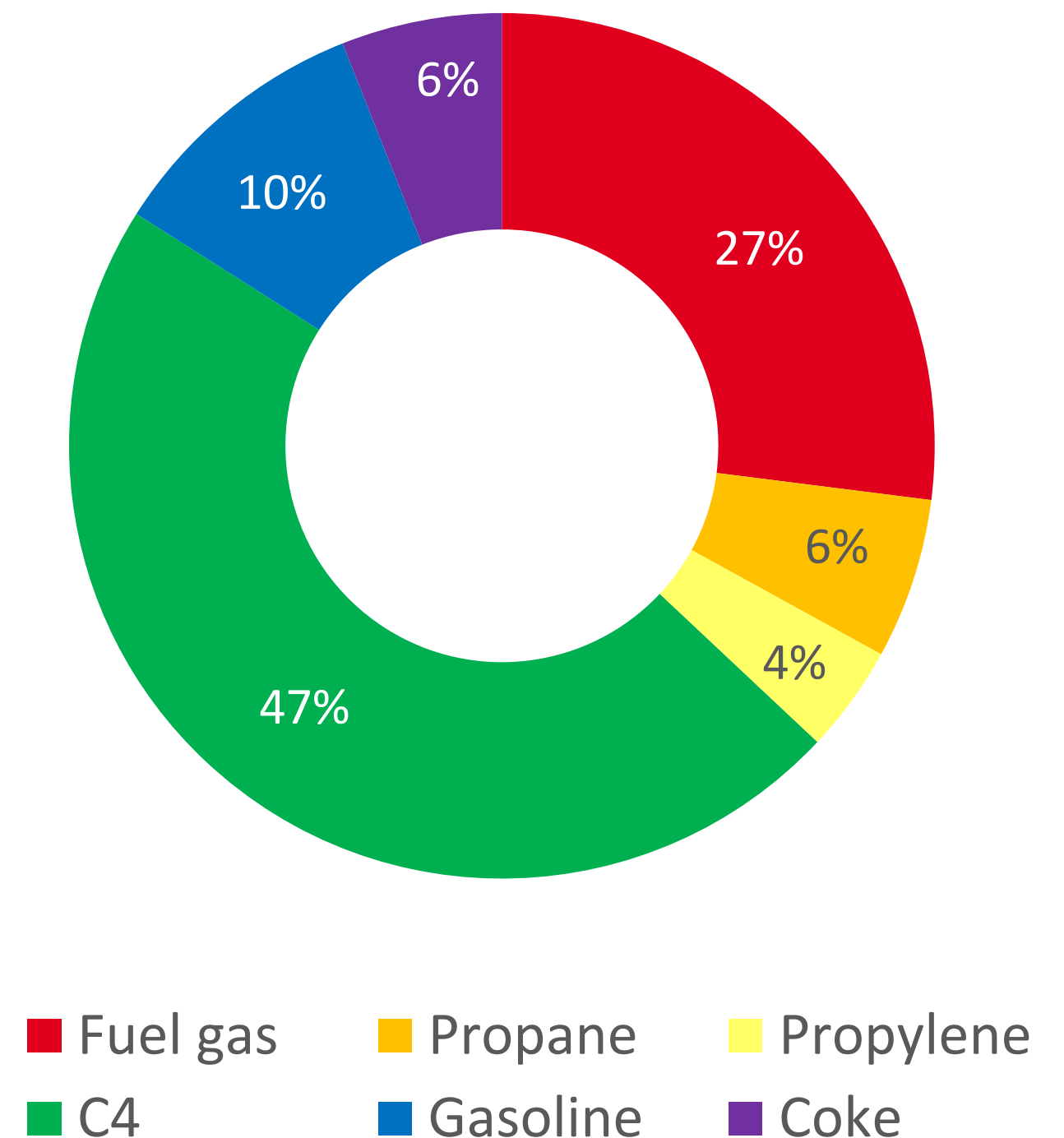
TEST RUN FOR IMPROVING C3= YIELD

- ▶ 5 m³/h OF NAPHTHA WAS PROCESSED (2.5% OF FEED)
- ▶ NO OPERATIONAL ISSUES
 - reactor parameters unchanged
- ▶ PROPYLENE YIELD LOWER THAN EXPECTED
- ▶ INCREASE OF GASOLINE POOL INSTEAD OF CHEMICAL NAPHTHA
 - ▶ No sulfur issue, mix feed was up to 500 ppm S
- ▶ THE BENEFIT IS THE FLEXIBILITY

NEXT STEPS

- ▶ DCU HEAVY NAPHTHA PROCESSING IN FCC IS UNDER INVESTIGATION

TEST RUN RESULTS YIELD GAINED FROM DCU LN



HSVGO PROCESSING IN FCCU

Motive:

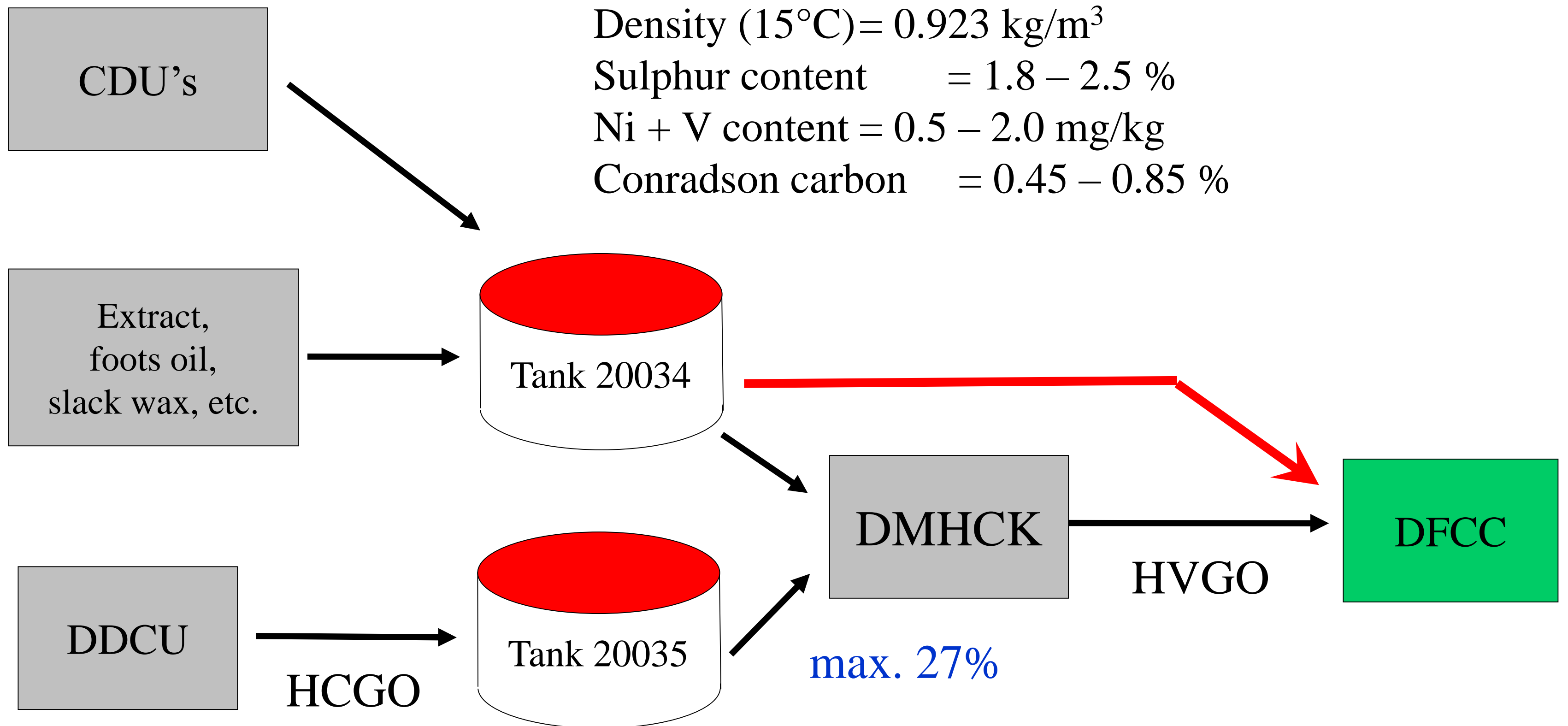
Lack of feed for FCCU in case of shut-down (catalyst replacement or TA) of FCC feed pretreater unit (MHCK)

- reduced FCC throughput
- or undesired shut-down of FCCU

Alternative:

Heavy sulphur containing VGO co-processing in FCCU

HSVGO PROCESSING



Density (15°C) = 0.923 kg/m³
 Sulphur content = 1.8 – 2.5 %
 Ni + V content = 0.5 – 2.0 mg/kg
 Conradson carbon = 0.45 – 0.85 %

Density (15°C) = 0.94 kg/m³
 Sulphur content = 2.0 – 2.6 %
 Ni + V content = 0.3 – 1.4 mg/kg

Conradson carbon = 0.5 – 1.2 %

High olefinicity!

Density (15°C) = 0.893 kg/m³
 Sulphur content = 150 – 350 mg/kg
 Ni + V content = 0.2 – 0.3 mg/kg
 Conradson carbon = 0.04 – 0.06 %

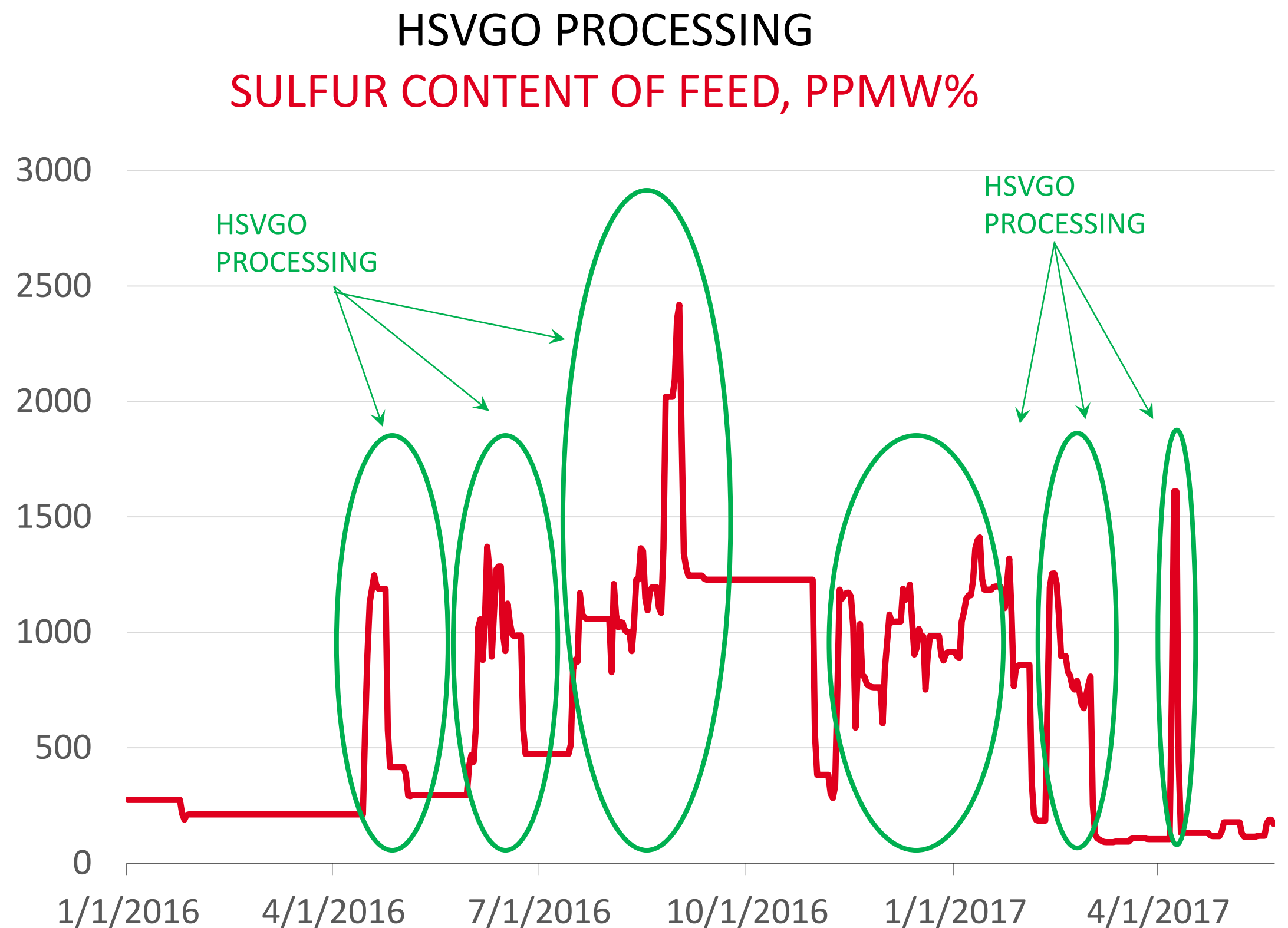
HSVGO PROCESSING

BASE CASE:

- ▶ FCC UNIT PROCESSING HYDROTREATED FEED FROM MHCK UNIT
- ▶ THE AVERAGE SULFUR CONTENT OF FEED IS 200 PPMW%.

ALTERNATIVE:

- ▶ IMPROVE REFINERY FLEXIBILITY 5-7% OF MHCK FEED CAN BE MIXED INTO FCC FEED.
- ▶ IN CASE OF HSVGO PROCESSING THE SULFUR CONTENT OF FEED JUMP TO ABOVE 1000 PPMW%.



HSVGO PROCESSING

► THE HIGHER SULFUR IN FEED THE HIGHER SULFUR IN FCC PRODUCTS

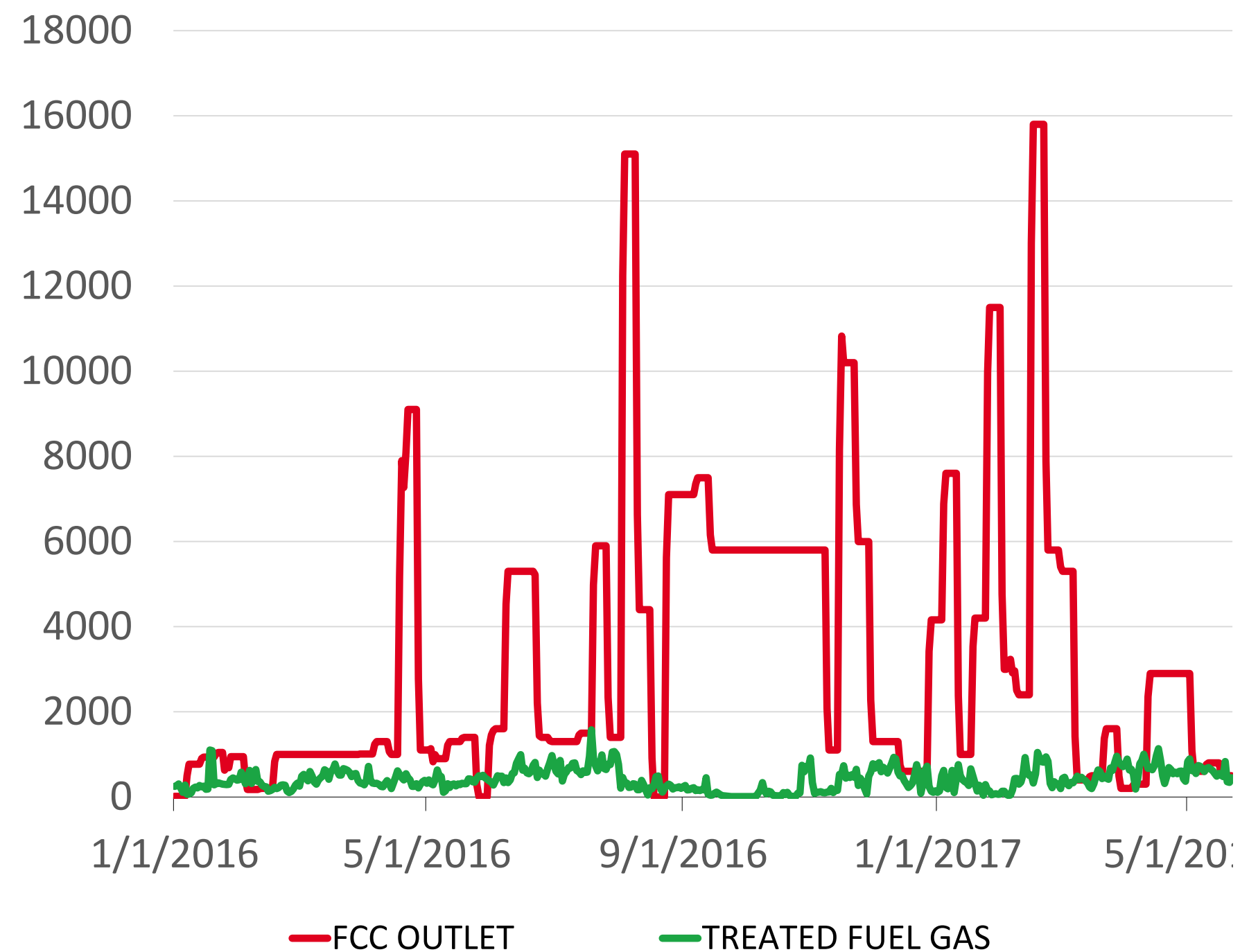
► FUEL GAS IS NOT TREATED IN FCC BUT PIPED TO CENTRAL GAS PROCESSING HEADER TO REMOVE SULFUR

► AS FEED SULFUR GOT HIGHER THE FULE GAS SULFUR CONTENT REACHED TO 1 W% !

► SPECIFICATION OF TREATED FUEL GAS IS MAXIMUM 250 PPMW.

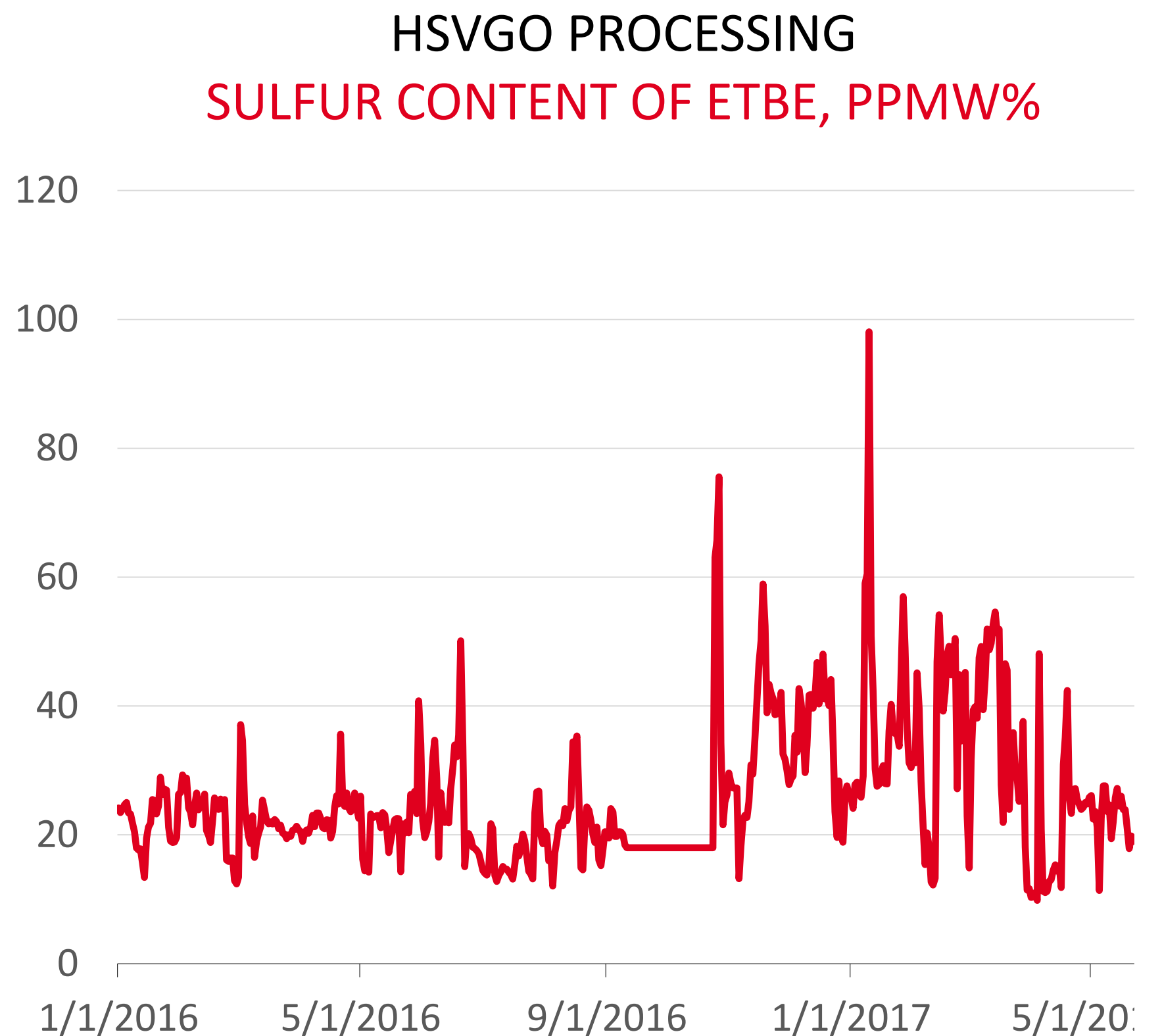
► GAS PROCESSING UNIT WAS ABLE TO MANAGE THE HIGHER FUEL GAS CONTENT FROM FCC.

HSVGO PROCESSING
SULFUR CONTENT OF FUEL GAS,
PPMW%



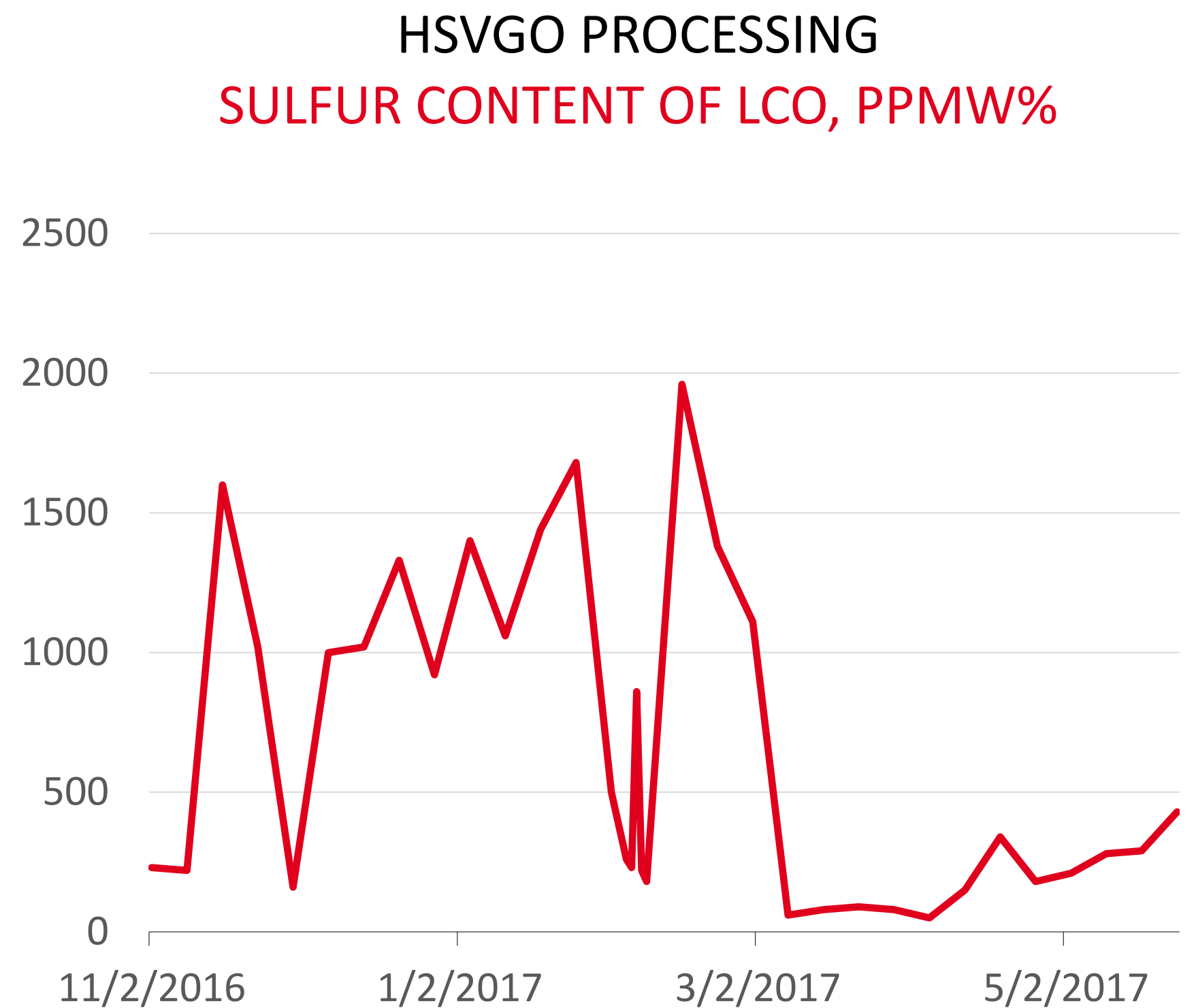
HSVGO PROCESSING

- ▶ LPG SULFUR CONTENT WAS HIGHER DURING HSVGO PROCESSING BUT LPG MEROX UNIT WAS ABLE TO HANDLE IT BY MORE ENERGY CONSUMPTION.
- ▶ SULFUR OF C4 CAN BE DETECTED IN ETBE PRODUCT (HIGHER THAN THE SPECIFICATION 50 PPMW%)
- ▶ PEAKS IN QUALITY ARE RATHER BELONG TO IMPORT C4 (DCU C4 TO ETBE) THAN HSVGO PROCESSING.



HSVGO PROCESSING

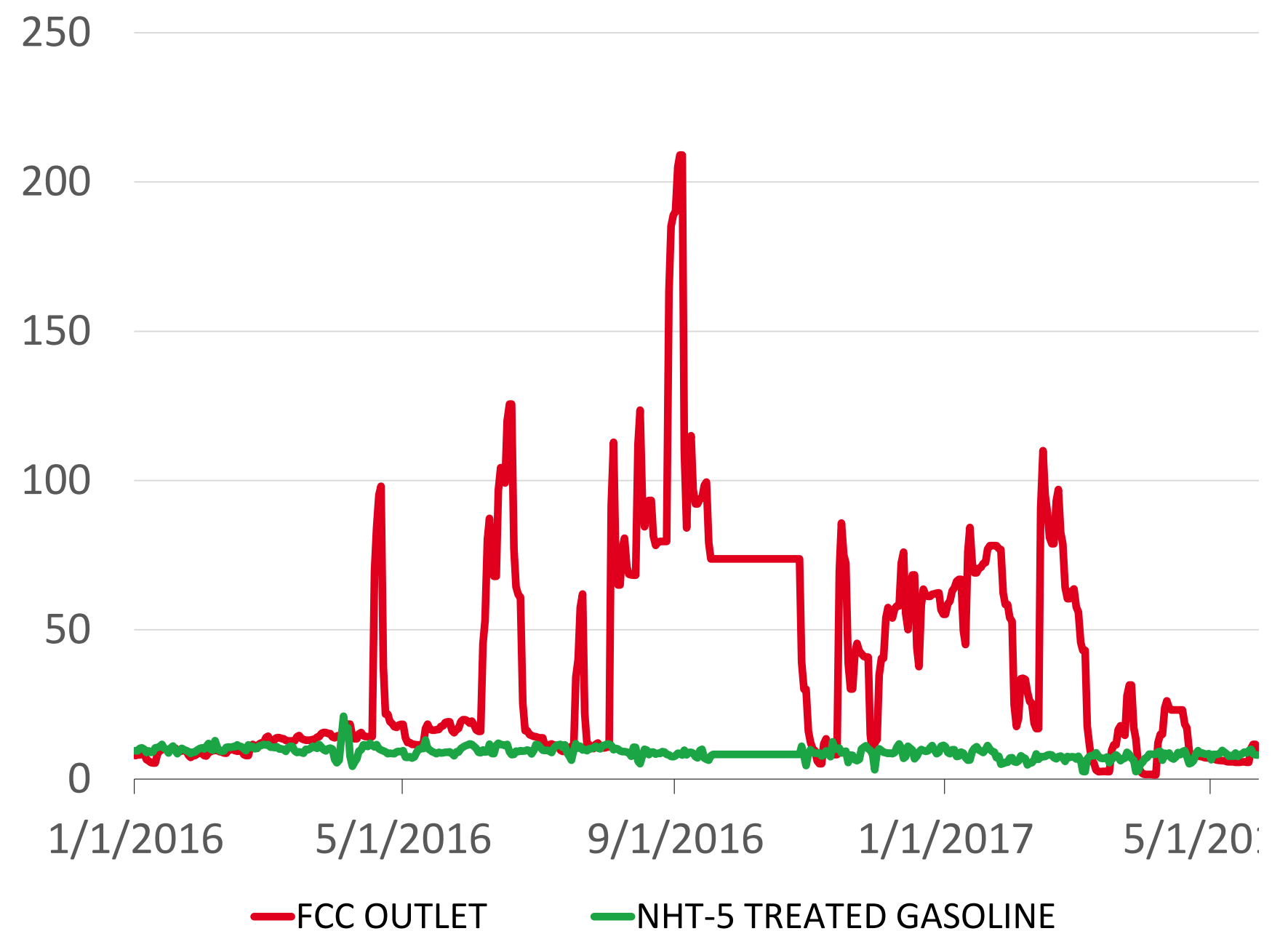
- ▶ DURING NORMAL OPERATION LCO USED TO HAS 50 TO 400 PPMW% OF SULFUR CONTENT
- ▶ THE MORE SULFUR THE MORE HYDROGEN CONSUMPTION IS EXPECTED IN GHT UNIT



HSVGO PROCESSING

- ▶ FCC GASOLINE HYDROTREATER UNIT (NHT-5) FEED SULFUR CONTENT DESIGNED FOR 70 PPM. DURING HSVGO PROCESSING IT WAS ABOVE 70 PPM
- ▶ HIGHER REACTOR TEMPERATURE AND MORE H₂ HELPED TO SOLVE IT.
- ▶ THE REMAINING LIFE TIME OF CATALYST IS SHORTENED.

HSVGO PROCESSING
SULFUR CONTENT OF GASOLINE,
PPMW%

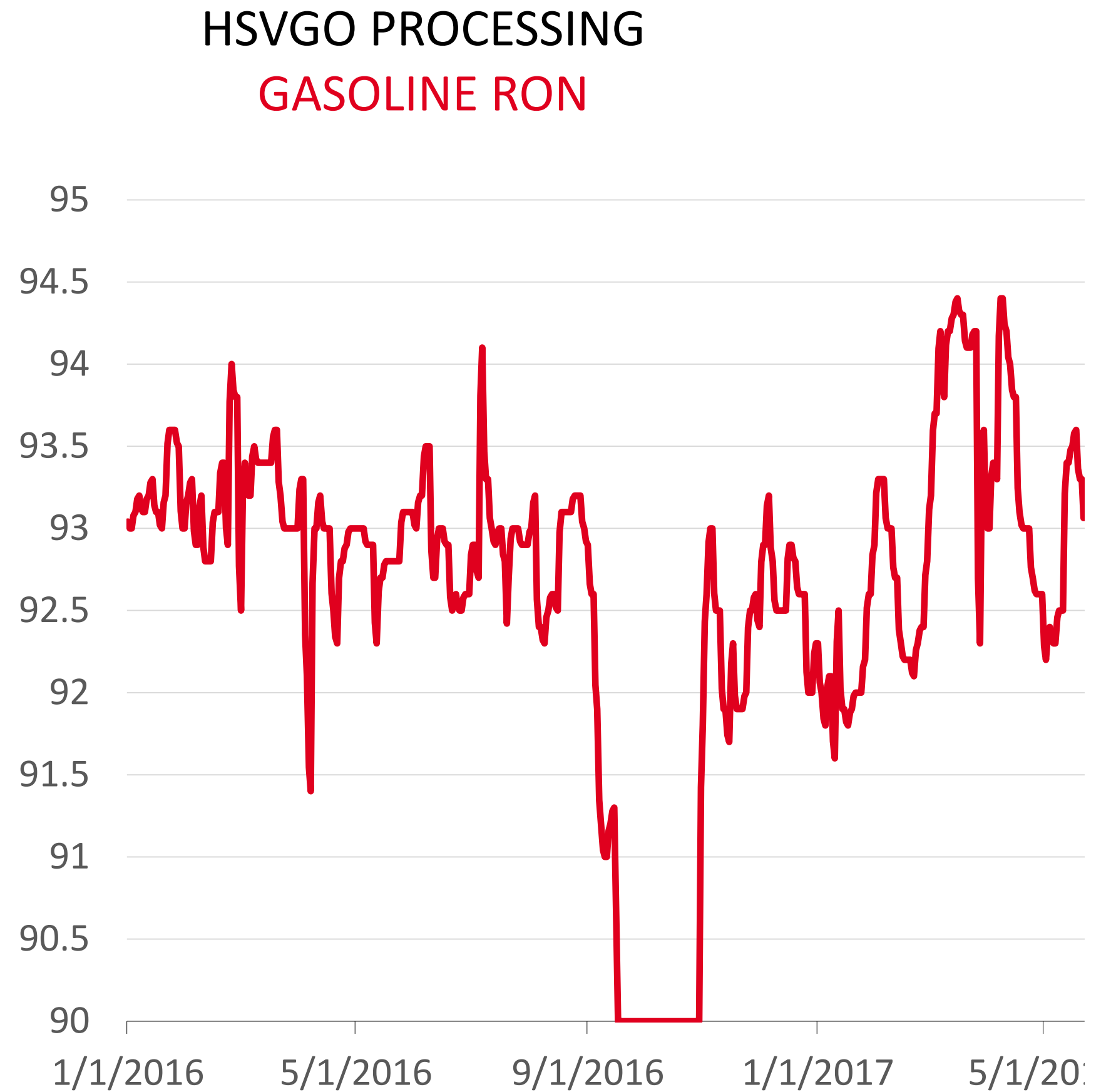


- ▶ SULFUR CONTENT OF HYDROTREATED GASOLINE WAS ACCORDING TO SPECIFICATION (< 10 PPM).

HSVGO PROCESSING

► HIGHER HYDROTREATING SEVERITY

- H2 consumption has doubled
- Gasoline RON loss increased up to about 2 unit



SUMMARY

- ▶ TWO TEST RUNS WERE EXECUTED TO IMPROVE FLEXIBILITY AS WELL AS PROFITABILITY.
- ▶ BENEFIT OF DCU LN PROCESSING IN FCC WAS LOWER THAN EXPECTED. IT CAN BE USED AS OPERATIONAL MODE IN FLEXIBILITY POINT OF VIEW.
- ▶ BYPASS MHCK UNIT AND PROCESS HSVGO IN FCC CAN ALSO BE A FLEXIBILITY ISSUE OF REFINERY.
- ▶ SULPHUR CONTENT OF BOTH STREAM DO NOT CAUSED PROBLEM IN PRODUCTS. NEITHER IN CASE DC LN NOR HSVGO.

A wide-angle photograph of an industrial facility, likely a refinery or chemical plant, during the golden hour of sunset. The sky is a mix of orange, yellow, and blue. In the foreground, there are large, complex structures with pipes and ladders. In the middle ground, several large, white, spherical storage tanks are visible. In the background, more industrial structures and smokestacks are silhouetted against the sky.

THANK YOU FOR
ATTENTION