



PETROVIETNAM
BSR

BINH SON REFINING & PETROCHEMICAL JSC

APEC WORKSHOP ON CLEANER AND MORE EFFICIENT OPERATION OF THE FOSSIL ENERGY INDUSTRY

ENERGY SAVING IMPROVEMENT AND FUEL GAS FLARING REDUCTION IN DUNG QUAT REFINERY



Tokyo, 3rd December 2025





BSR



**INTRODUCTION TO DUNG QUAT
REFINERY AND BSR**



**ENERGY SAVING IMPROVEMENT &
FUEL GAS FLARING REDUCTION**



KEYNOTE TAKEWAY

I. INTRODUCTION TO DUNG QUAT REFINERY AND BSR

- Location: Quang Ngai Province – Center of Vietnam
- Total area: 956 hectares.
- Design capacity: 6.5 MMT/Year
- Total capex investment: ~ 3 billions USD
- Products: 97.5% Refining Fuels and 2.5% Petrochemicals (Polypropylene)

11/2005



- Signed the EPC contract with Technip Consortium.
- Groundbreaking of project was started.

12/2008



- Binh Son Refining and Petrochemical Company Limited was established
- Dung Quat Refinery was completed construction and put in operation.

1/2011



- Final acceptance and inauguration of Dung Quat Refinery.

7/2018



- BSR shares were traded on UPCOM and become a Joint Stock Company.

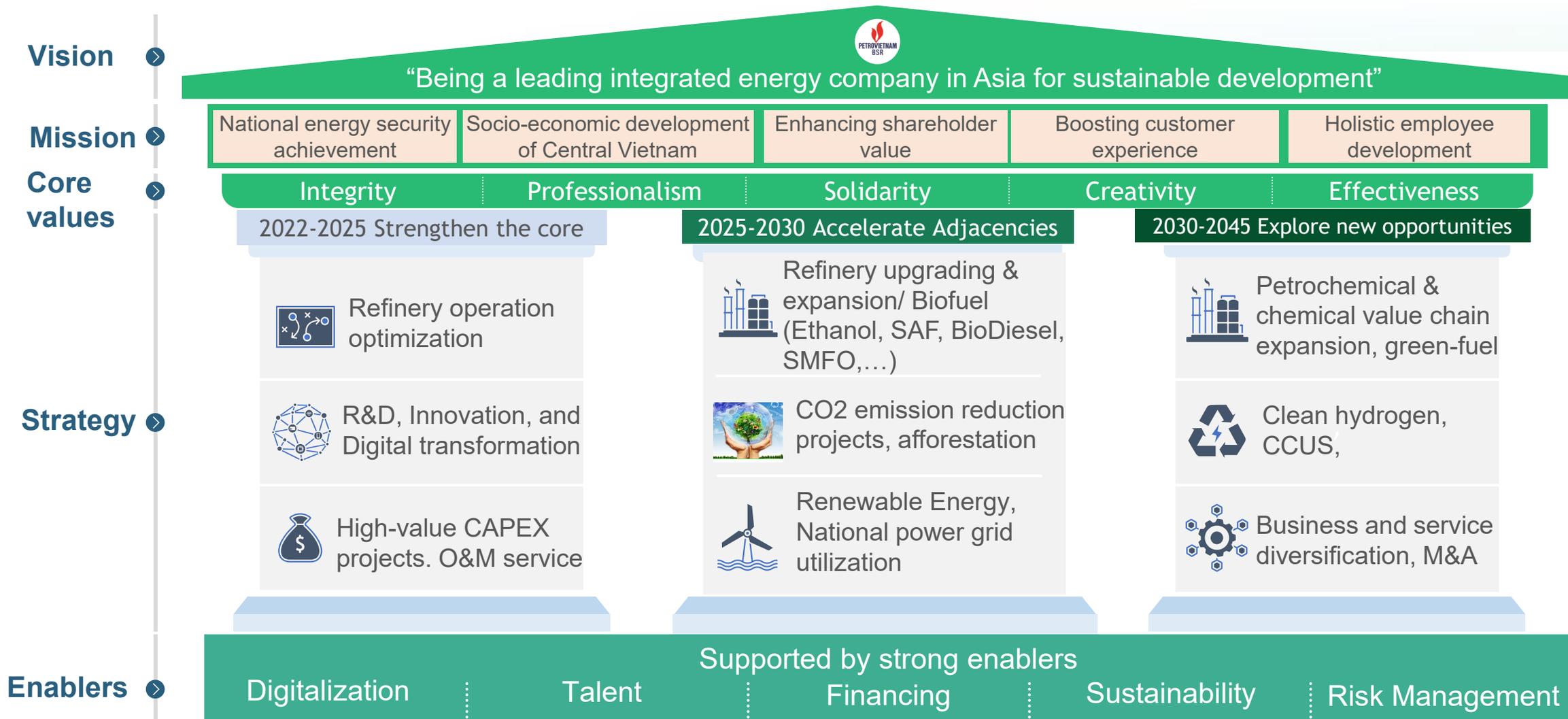
12/2025



- Processed 115 million tons of crude oil
- Executed 5 Turnarounds successfully
- Achieved over 54 million safe working hours since 2013
- Awarded Operation Excellence by Licensors & Insurers.



I. INTRODUCTION TO DUNG QUAT REFINERY AND BSR



BSR has established & leveraged a development strategy to 2030 and vision to 2045 with the aim of being a leading integrated sustainable energy company through the refinery optimization, diversification and innovation

I. INTRODUCTION TO DUNG QUAT REFINERY AND BSR

Roadmap For Green House Gas Emission Reduction Of Dung Quat Refinery

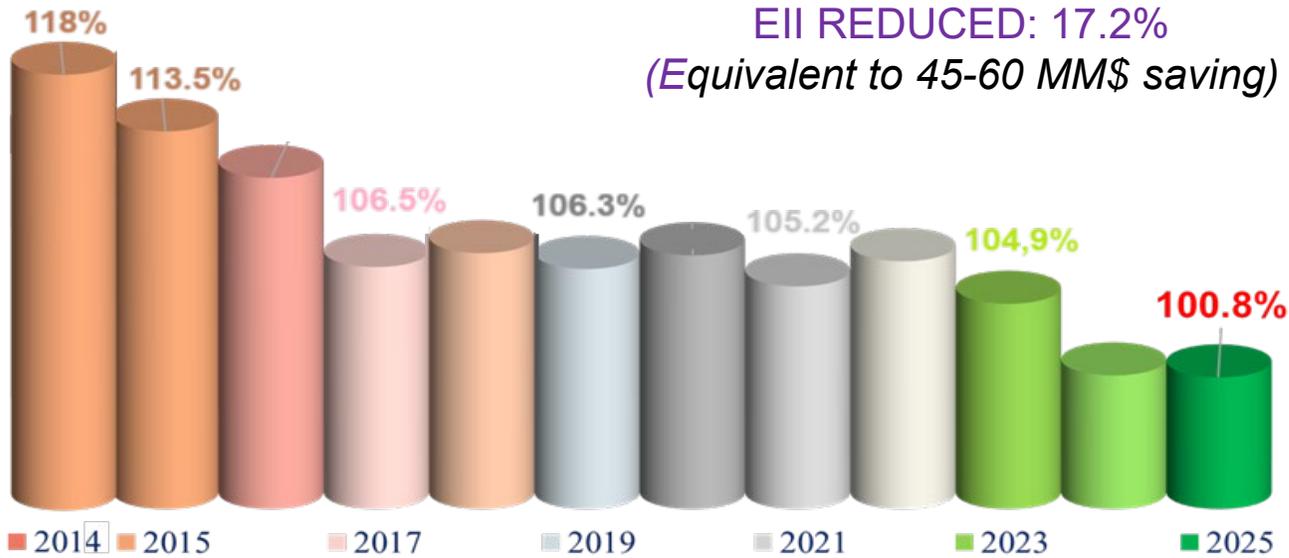
Contents	Emission reduction plan (*)			
	Case 1	Case 2	Case 3	Case 4
GHG reduction target by 2050	90%	100%	35-40%	10-12%
Investment costs (million \$)	~ 1,800	~2,100	~700	~170
Solutions				
1. Energy saving, %	7.70	7.70	7.70	7.70
2. Renewable energy, %	2.02	2.02	2.02	2.02
3. CCUS, %	77.40	77.40	22.45	0
4. Afforestation, %	2.33	6.53	2.33	1.14
5. Buy carbon credits, %	2.33	6.53	2.33	1.14
Total of GHG reduction. %	91.6	100	36.6	12.00

() Plan may be changed depending on government regulations, policies and carbon credit market conditions.*

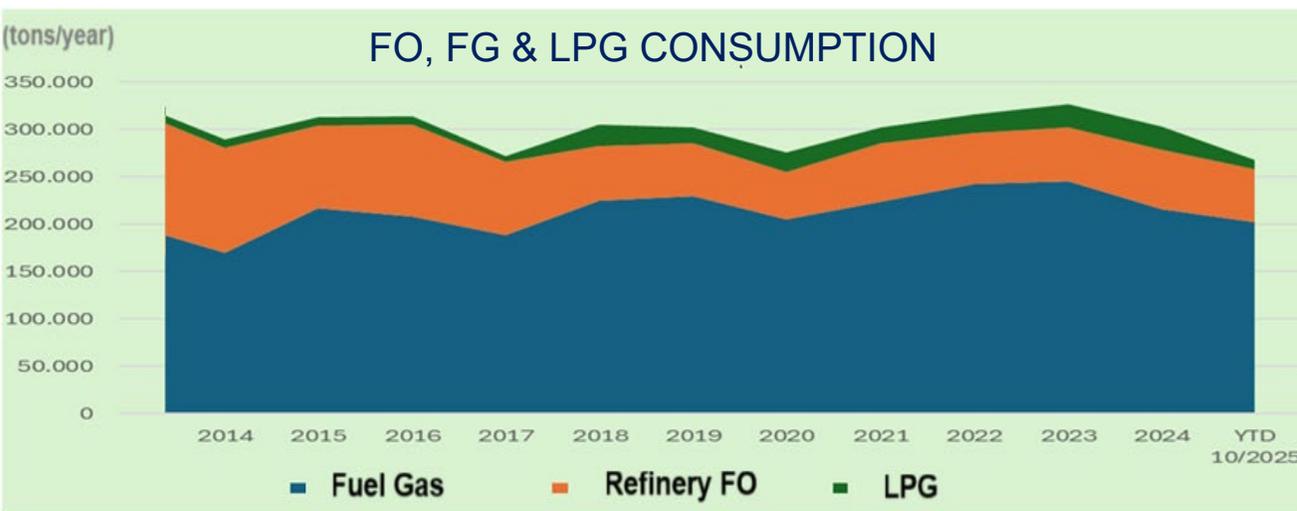
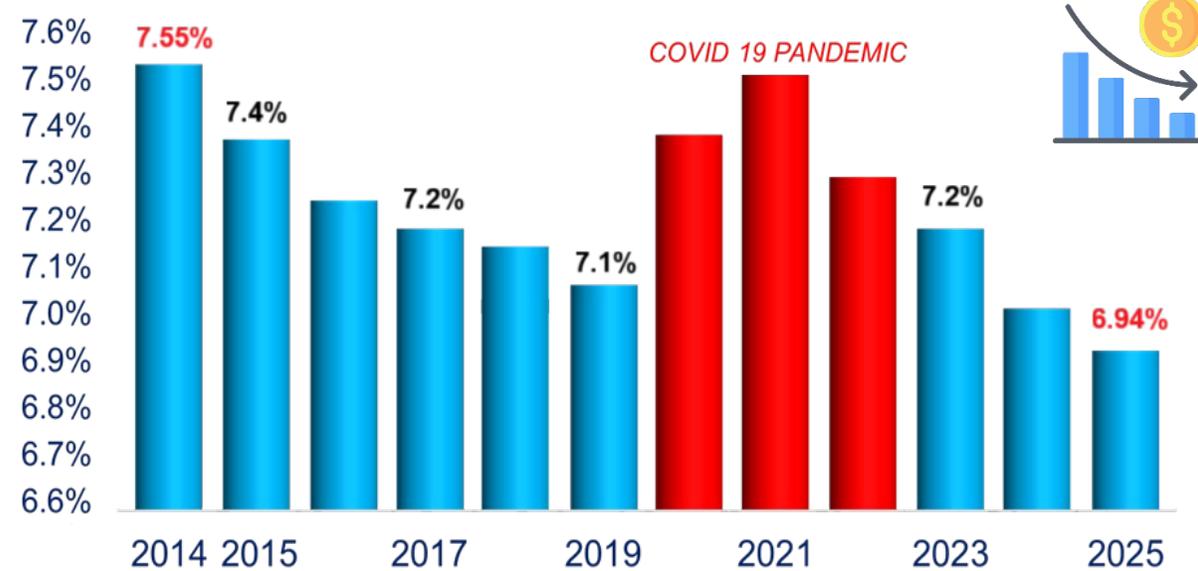
BSR has outlined 4 scenarios for decarbonization roadmap by 2050 combines energy efficiency, renewable energy, CCUS, afforestation, and carbon credits to achieve 10%–100% GHG reduction depending on the strategic investment and budget control.

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION

DUNG QUAT REFINERY EII 2015-2025



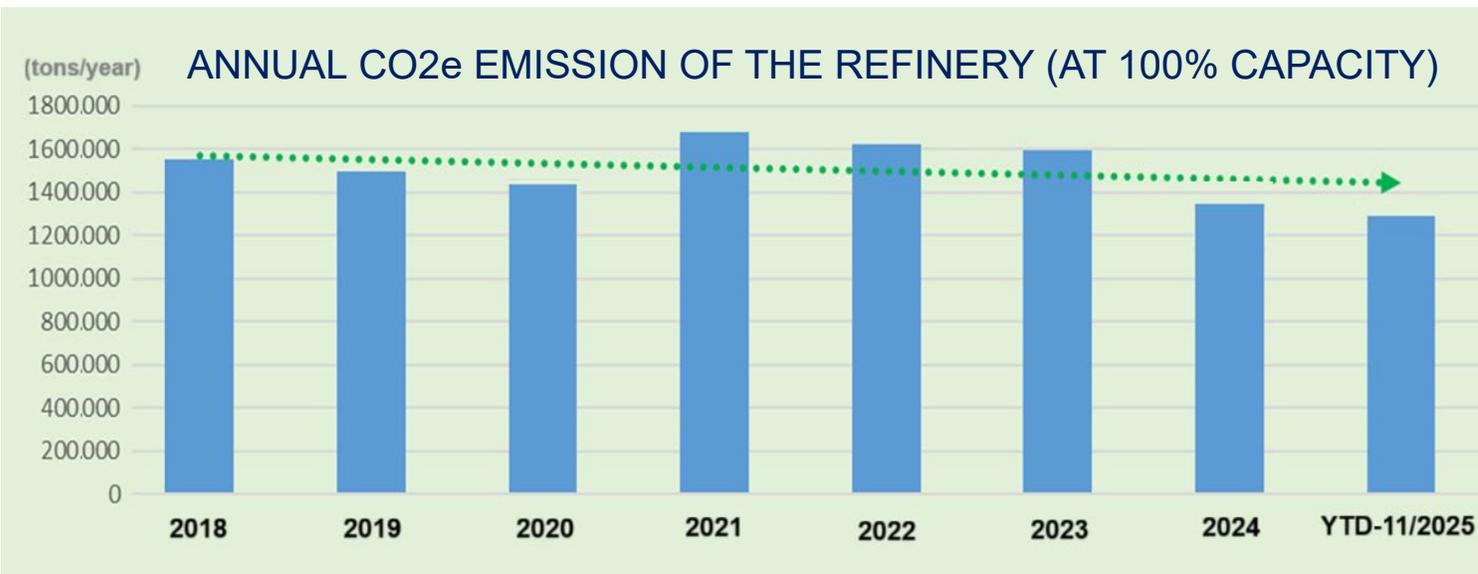
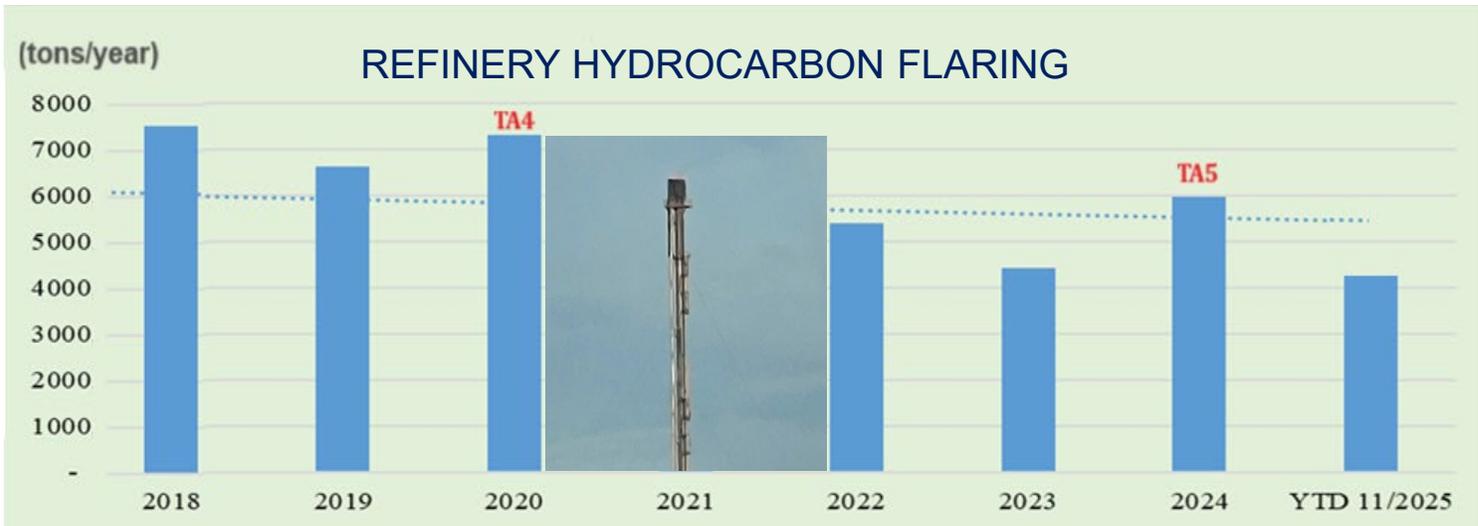
INTERNAL ENERGY CONSUMPTION 2014-2025



Through continuous optimization and breakthrough solutions, Dung Quat Refinery achieved a 17.2% EII reduction, significantly lowered internal energy consumption by 0,6%, and transitioned from FO to cleaner FG and LPG, delivering significant efficiency and emission benefits.

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION

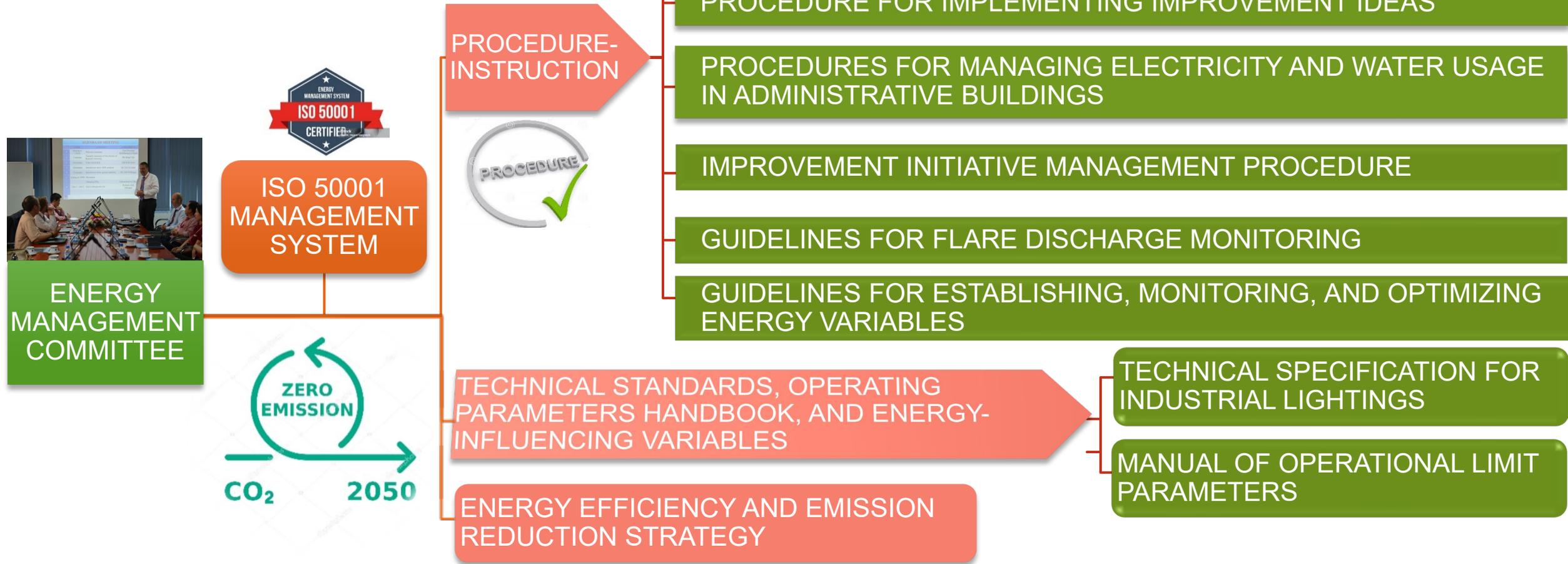
Refinery Hydrocarbon Flaring and CO2 Emission From 2018 To 2025



- ❖ Dung Quat Refinery has significantly reduced hydrocarbon flaring over the years, with clear downward trends to ~ 4500 tons/year (0.05%) despite turnaround periods, reflecting strong operational performance and effective implementation of flare-reduction initiatives. Its target is to achieve “zero flaring” by 2030.
- ❖ Total CO₂e emissions have steadily declined from 2018 to 2025 thanks to continuous energy optimization, fuel switching, and advanced emission-reduction measures across the refinery.

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION

BSR Integrated Energy & Emission Management System



By implementing a comprehensive ISO 50001 energy management system with clear policy, strategy, procedures, guidelines, and technical standards, It has strengthened operational excellence, enabling significant reductions in EII, internal energy consumption, and CO₂ emission.

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION

Principles of Energy Optimization and Gas Flaring Emission Reduction

Maintain effectively ISO 50001 Energy Management System
Encourage internal innovation, energy-saving & gas emission reduction

Control at optimal operating conditions:
Column, HEx, Heater, Pump, Compressor



Reduce energy and fuel loss: No venting
and hydrocarbon flaring

Maximize internal heat recovery/
integration



Recover and reuse flare gas
through FGRS system

Optimize overall utility systems: Steam,
Power, Letdown,...



Integrate renewable and low-carbon
energy solutions

Apply advanced & real time energy saving technology and
management: APC, VFD, Visual Mesa, Power BI,...

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION



Operational Optimization & Energy Efficiency Improvement Solutions

No	Unit	Improvement solutions	Objectives	Investment	Year	Benefits	Payback
1	Utility	Stopped 1 Air Compressor	Power saving	Optimization	2018	<ul style="list-style-type: none"> 2,300 tons FO/year 0.4% EII 1.100.000 USD/year 	
3	NHT	Optimed capacity of 2 Make-up Gas Compressor (90/90 to 50/50)	Power saving	Optimization	2019	<ul style="list-style-type: none"> 1,500 tons FO/year 0.26% EII 825.000 USD/year 	
4	Sea Water Intake	Stopped 1 Seawater Pump	Power saving	Optimization	2021	<ul style="list-style-type: none"> 3,050 tons FO/year 0.6% EII 1,600,000 USD/year 	
5	CDU	Installed additional Heat Exchanger E-1135	Heat recovery	Optimization	2024	<ul style="list-style-type: none"> 550 tons FO/year 0.1% EII 200.000 USD/year 	
6	RFCC	Optimized E-1525 inlet BFW temperature	Reducing MP Steam consumption	Optimization	2024	<ul style="list-style-type: none"> 1,000 tons FO/year 0.2% EII 515,000 USD/year 	
7	RFCC	Switched COB FDF from Turbine to Motor	Addressing LP steam venting Energy saving	Optimization	2025	<ul style="list-style-type: none"> 2,200 tons FO/year 1% EII 3,000,000 USD/year 	

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION



Ongoing & Upcoming Key Energy Improvement Projects

No	Unit	Improvement solutions	Objectives	Investment (USD)	Year	Benefits	Payback
1	Utility	Installing inverter for Electric Motor	Power saving	700,000	2029	<ul style="list-style-type: none"> 1,500 tons FO/year 0.3% EII 772,000 USD/year 	01 years
2	CDU	Air Preheater Installation for Charge Heater H-1101	Heat Recovery Save Fuel Gas	5,000,000	2025-2030	<ul style="list-style-type: none"> 5,000 tons FO/year 0.7% EII 1,900,000 USD/year 	< 4 years
3	Power Plant	Installation 01 gas turbine instead of steam turbine	Energy efficiency improvement	35,000,000	2025-2030	<ul style="list-style-type: none"> 10,800 tons FO/year 2% EII 5,500,000 USD/year 	< 2 years
4	Power Substation	Import power from national grid (EVN)	Cheap and Cleaner Energy	15,000,000	2025-2029	<ul style="list-style-type: none"> 8,500 tons FO/year 1.5% EII 4,000,000 USD/year 	< 5 years
5	Under study	Wind Power Plant with 50 MW	Green Energy CO2 reduction	Under study	2027-2030	<ul style="list-style-type: none"> Under study 	Under study

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION



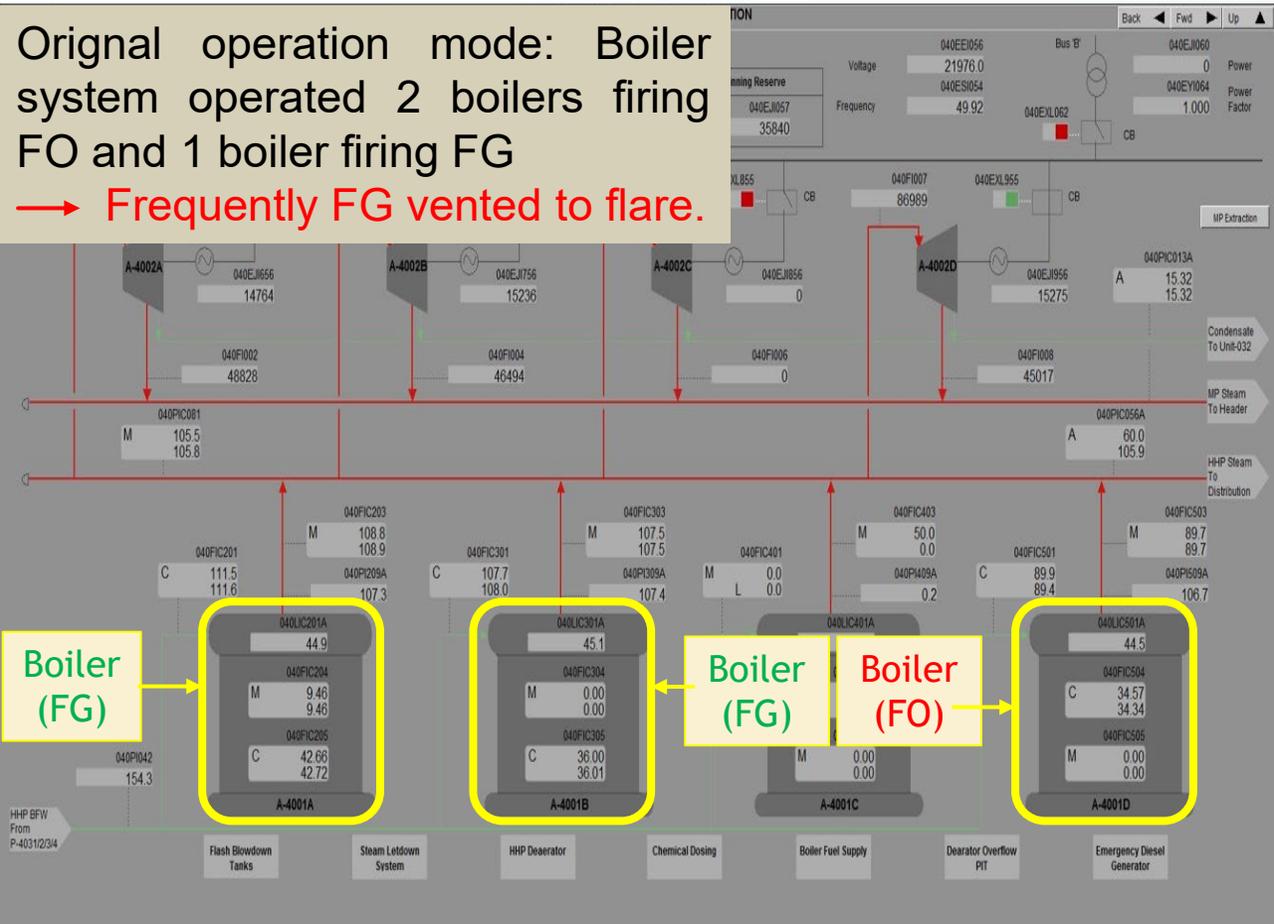
Fuel Gas Flaring Reduction Solutions And Ongoing Projects

No	Unit	Improvement solutions	Objectives	Investment (USD)	Year	Benefits	Payback
1	CDU	Install 2" pipeline to sending excessive Off-Gas to RFCC	<ul style="list-style-type: none"> Recover Off-Gas venting to Flare 	538,000	2015	<ul style="list-style-type: none"> 1080 tons FO/year 0.2% EII 410,000 USD/year 	< 1.5 years
2	PP Plant	Install 2" pipeline to sending Off-Gas from PP Plant to RFCC	<ul style="list-style-type: none"> Recover Off-Gas venting to Flare 	80,000	2024	<ul style="list-style-type: none"> 3400 tons FO/year 0.6% EII 1,300,000 USD/year 	< 1 year
3	Process units	Using N2 as sweeping gas (FG) at process units for flare system	<ul style="list-style-type: none"> Minimize FG purging to Flare Emission reduction 	150,000	2025	<ul style="list-style-type: none"> 3,369 tons FO/year 0.6% EII 1,280,000 USD/year 	< 1 year
4	Fuel Gas System	Replace FO with LNG	<ul style="list-style-type: none"> Energy saving Emission reduction 	2,000,000	2026	<ul style="list-style-type: none"> ~1-2% EII ~2,000,000 USD/year 40 – 100 ktons CO2/year 	< 2 years
5	Refinery Flare	Install a FGRS at Main Flare	<ul style="list-style-type: none"> Recover valuable FG for reuse Emission reduction 	5,000,000	2030	<ul style="list-style-type: none"> 4828 tons FO/year 1,500,000 USD/year 6,165 tCO2/year 	< 5 years

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION

Changing operation mode of boiler system: Switched two boiler firing FO and one boiler firing FG into 2 FG boilers and 1 FO boiler

Implementation steps



Calculated and evaluated the Fuel Gas and Fuel Oil network balance of the Refinery.

Conducted the risk assessment and implement a MOC.

Issued steam load shedding guidelines and other related procedures for abnormal situations of the refinery fuel gas network. Carried out training program and operational drills for operators.

Changed the boiler operation mode into 2 FG Boilers and 1 FG boiler in 2014 to maximize FG consumption.

Saved approximately 3 – 4 tons of Fuel Gas per hour, equivalent to 27,000 – 36,000 tons per year.

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION

Dual-firing Boiler Solution: Operated two burners firing FO and one burner firing FG.

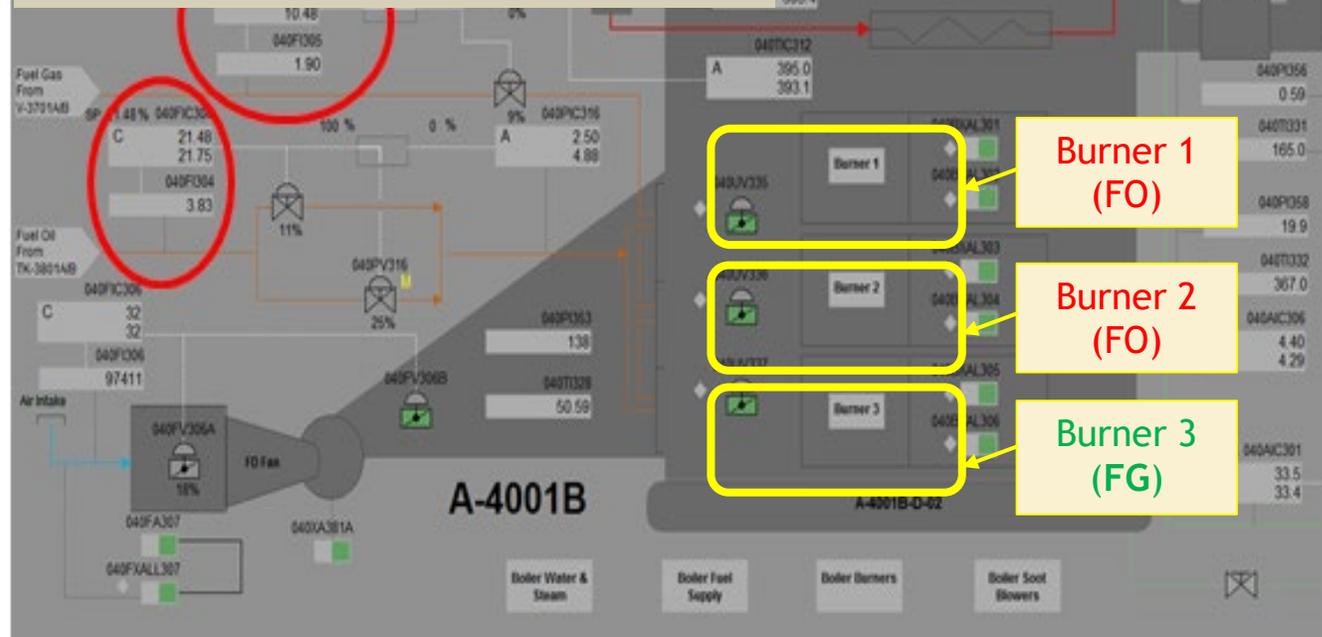
Implementation steps

Original Design: Boiler can firing only one fuel type (FG or FO or DO) as the same time.

Normal operation mode:

- 02 Boiler: FG firing
- 01 Boiler: FO firing

→ Frequently FG vented to flare.



Conducted trial test the boiler operating with two burners using FO firing and one burner fuel gas (FG) firing, adjust the optimal fuel-to-air ratio.

Collected data and developed a new operating curve for dual-fuel combustion, with two burners firing fuel oil and one burner firing gas fuel.

Designed a new control logic to enable stable and safe dual-fuel operation

Developed procedures, operating guidelines, and abnormal handling instructions for this application.

Selected an appropriate boiler operating mode since 2017 to prevent excessive FG being flared.

Benefits of Dual-firing of Boilers



Save/reduce approximately **6.128 tons of Fuel Oil** consumption per year.



Develop an operating procedure for boilers in dual-fuel mode firing and handle abnormalities in case of incidents.



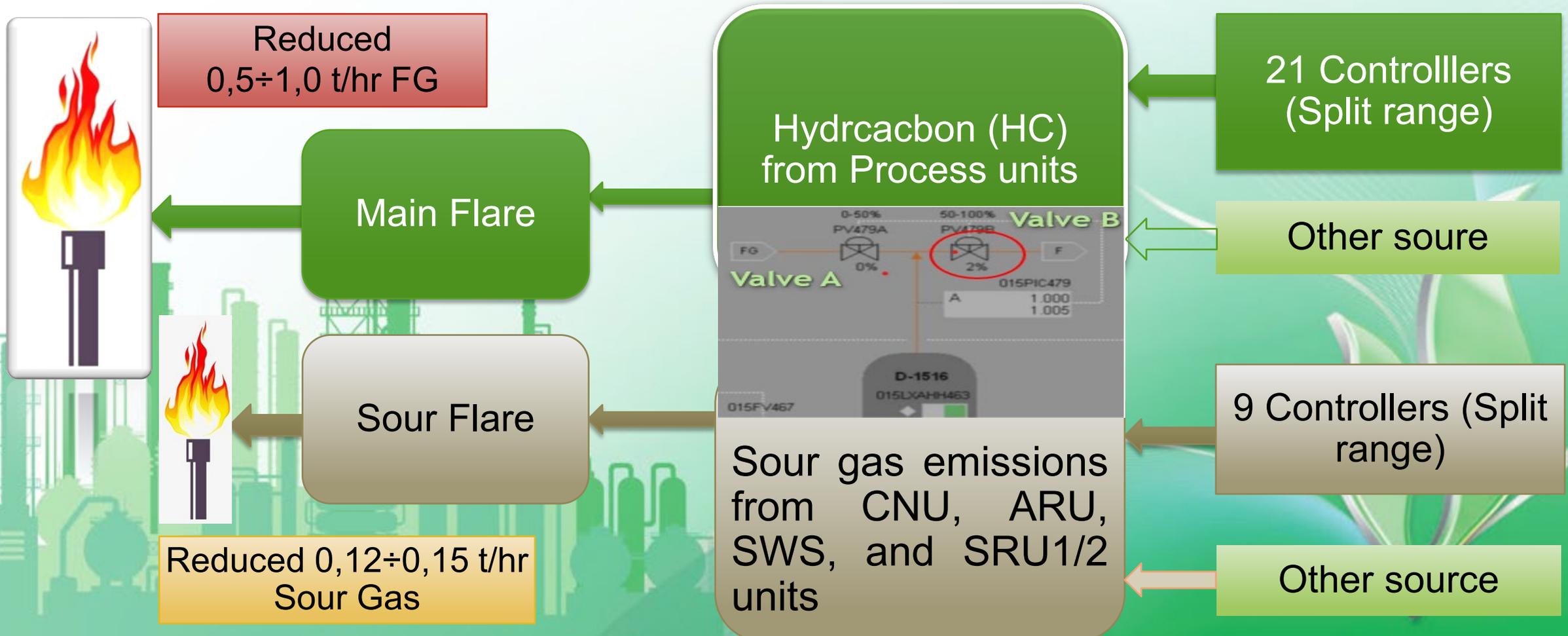
No investment cost, the benefits amount to approximately **3.7 million USD per year**.



Reduce CO₂ emissions at Dung Quat Refinery by approximately **19,082 tons per year**.

II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION

Change of control principle: Switch from split range controller to independent dual control (couple controller) and adjust the pressure setpoint values of valve A&B controllers to minimize the amount of hydrocarbon gas and sour gas flared.



II. ENERGY SAVING IMPROVEMENT & FUEL GAS FLARING REDUCTION

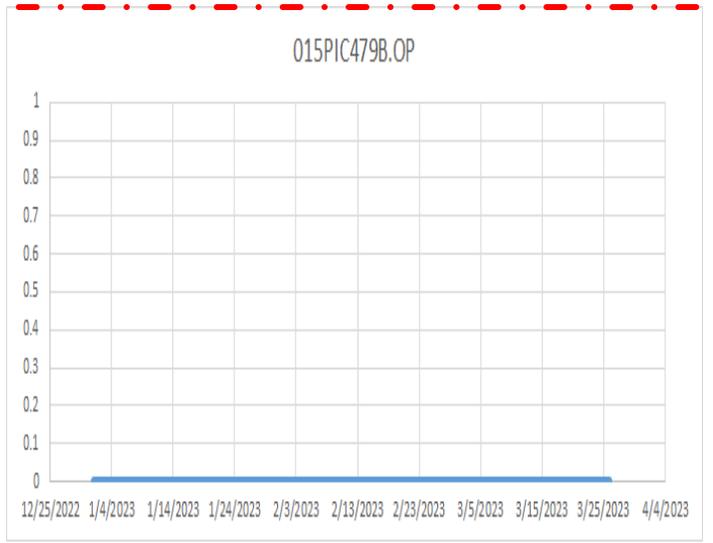
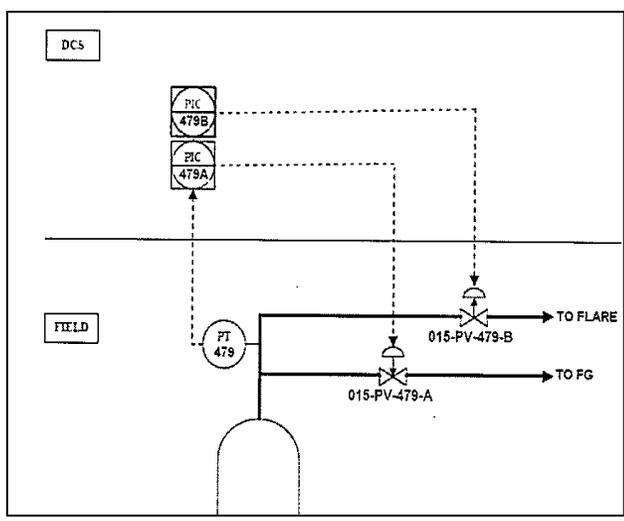
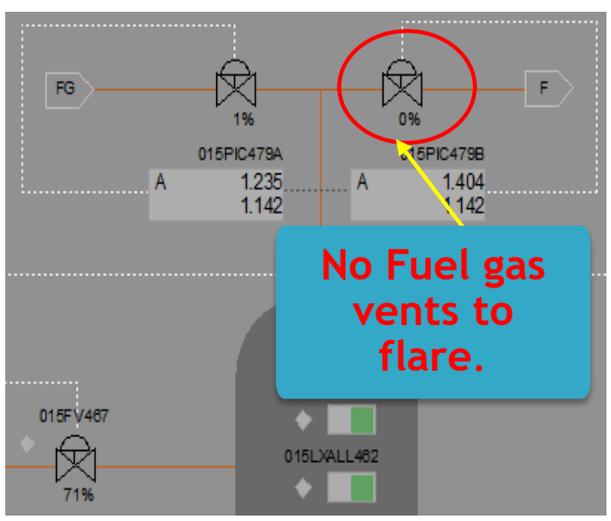
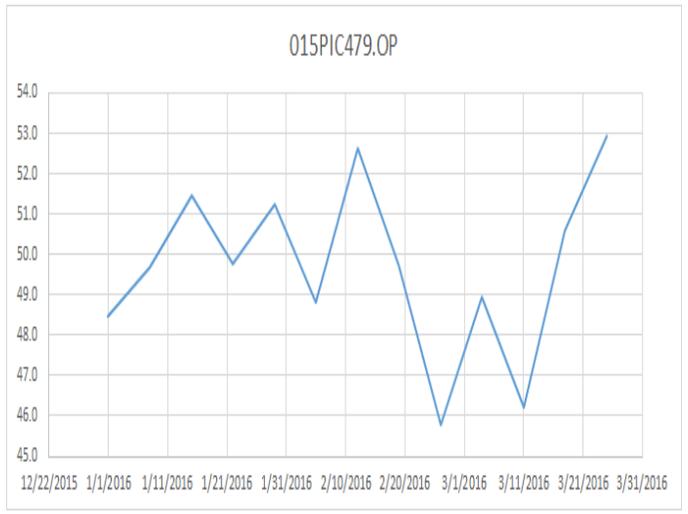
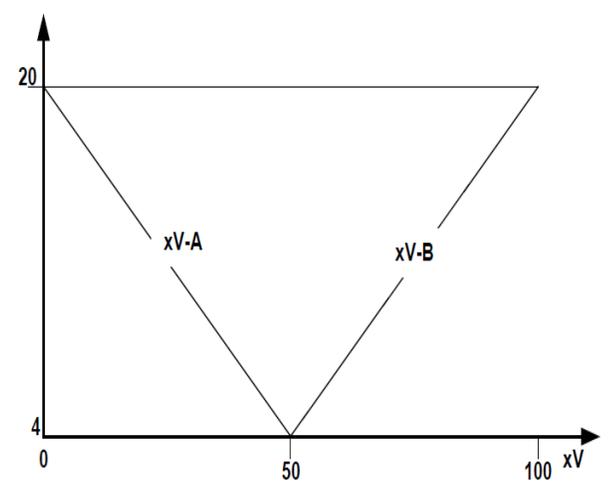
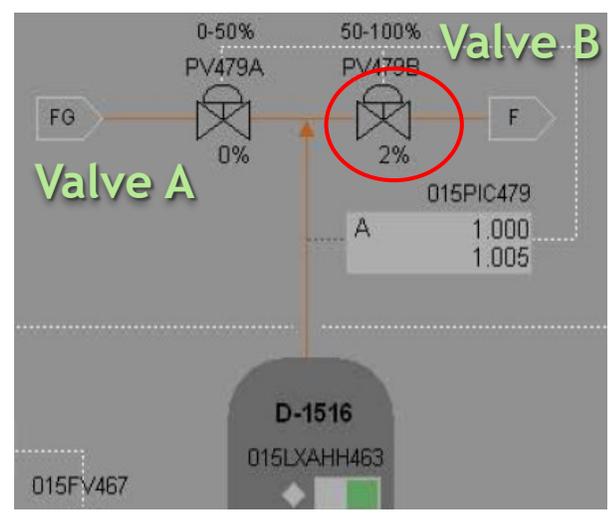
Results of the solution

Before

BEFORE

AFTER

After

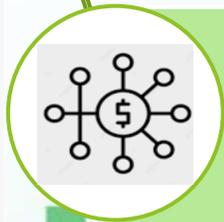


III. KEYNOTE TAKEAWAY

Creativity and Innovation



Dung Quat Refinery has delivered remarkable energy performance improvements and substantial hydrocarbon flaring & CO2 emission reduction. Targeting to EII < 95%, zero flaring by 2030 and Net-Zero in 2050.



BSR's integrated energy & emission management system with clear policies, strategies, procedures and KPI's ensure successfully disciplined governance and continuous improvement across all operation.



Strong technical innovation enable BSR to successful energy transition and deeper decarbonization. In addition, strengthening cooperation with ASIA energy companies (ENEOS, COSMO, SK, PETRONAS...), licensors, vendors, and consultants to aim sustainable development.



BSR is committed to a long-term low carbon transition aligned with global energy trends. Its 2050 roadmap integrates energy efficiency, renewable & clean energy, CCUS, afforestation and carbon credits.



THANK YOU!