



Energy Integration with a Benign Environment Approach in the ECO-PAG Project



PTT Public Company Limited

Presented by

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5th ENERGY COP CONFERENCE

SPEAKER



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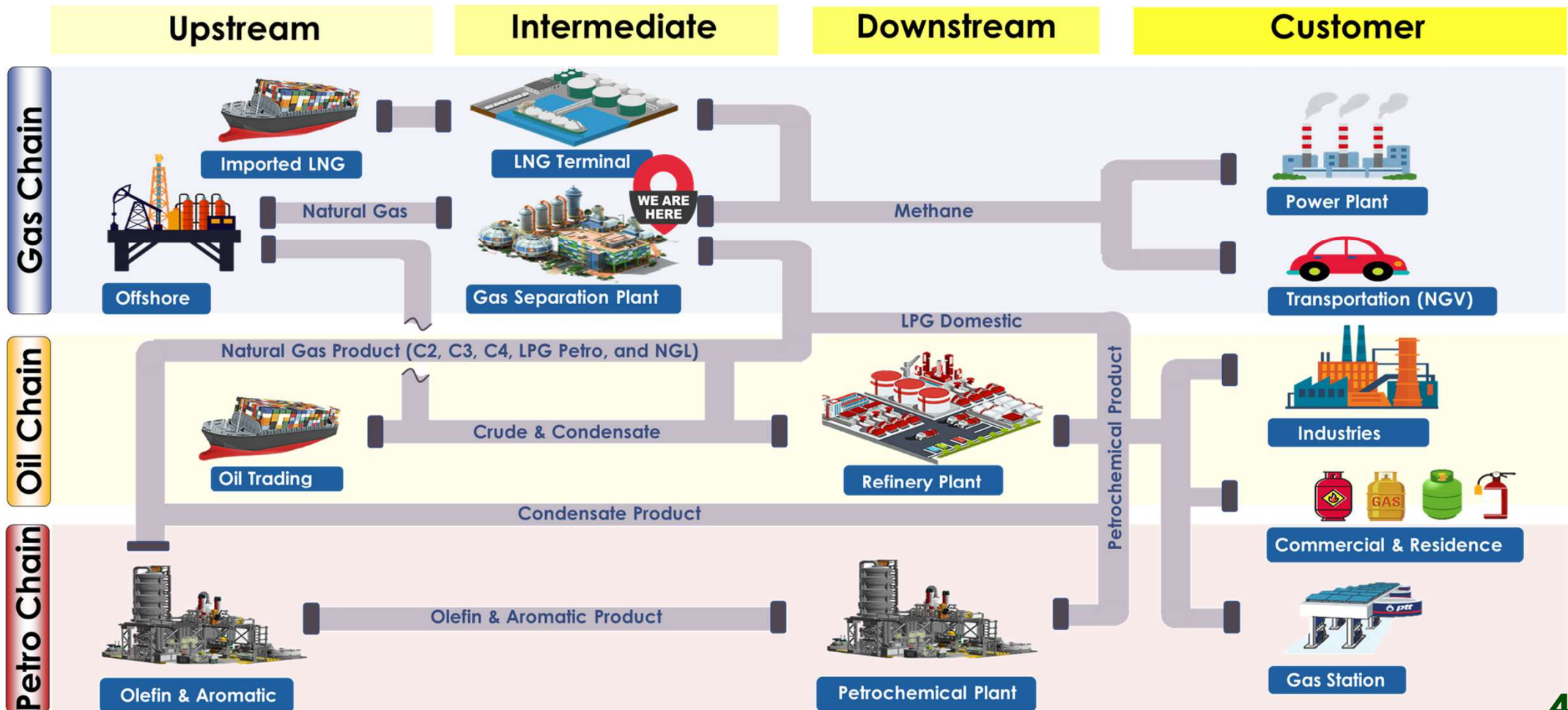
PTT PLC

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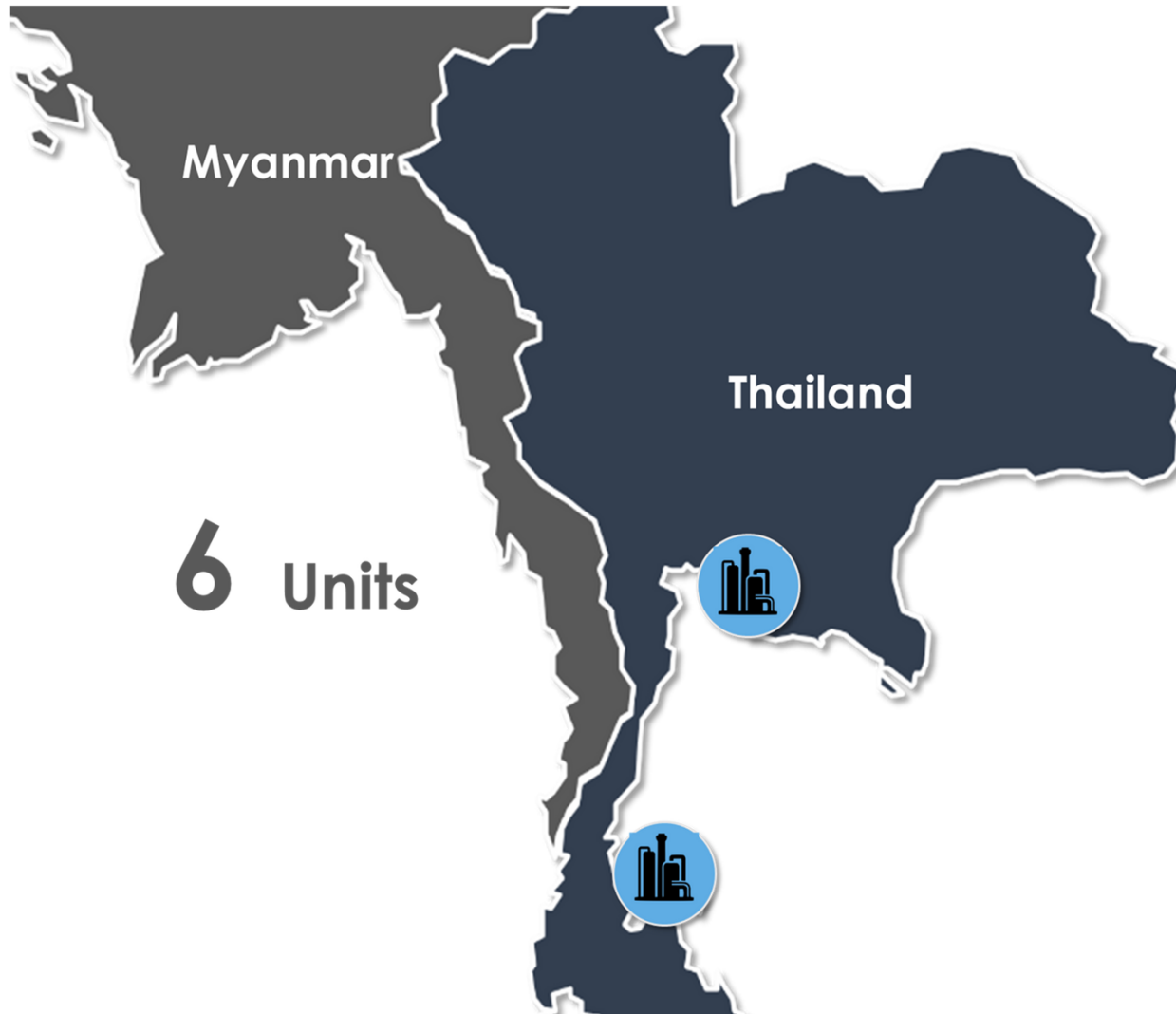
- ABOUT PTT
- Environmental Problems
- What is ECO-PAG?
- Application of Heat Recovery Section



PTT'S BUSINESS



GSP : ROLE & RESPONSIBILITY



Gas separation plants are responsible for separating different types of hydrocarbon component from natural gas, **in order to create massive added value of natural gas**

1

To Ensure Thailand's Energy Security
(LPG Domestic)

2

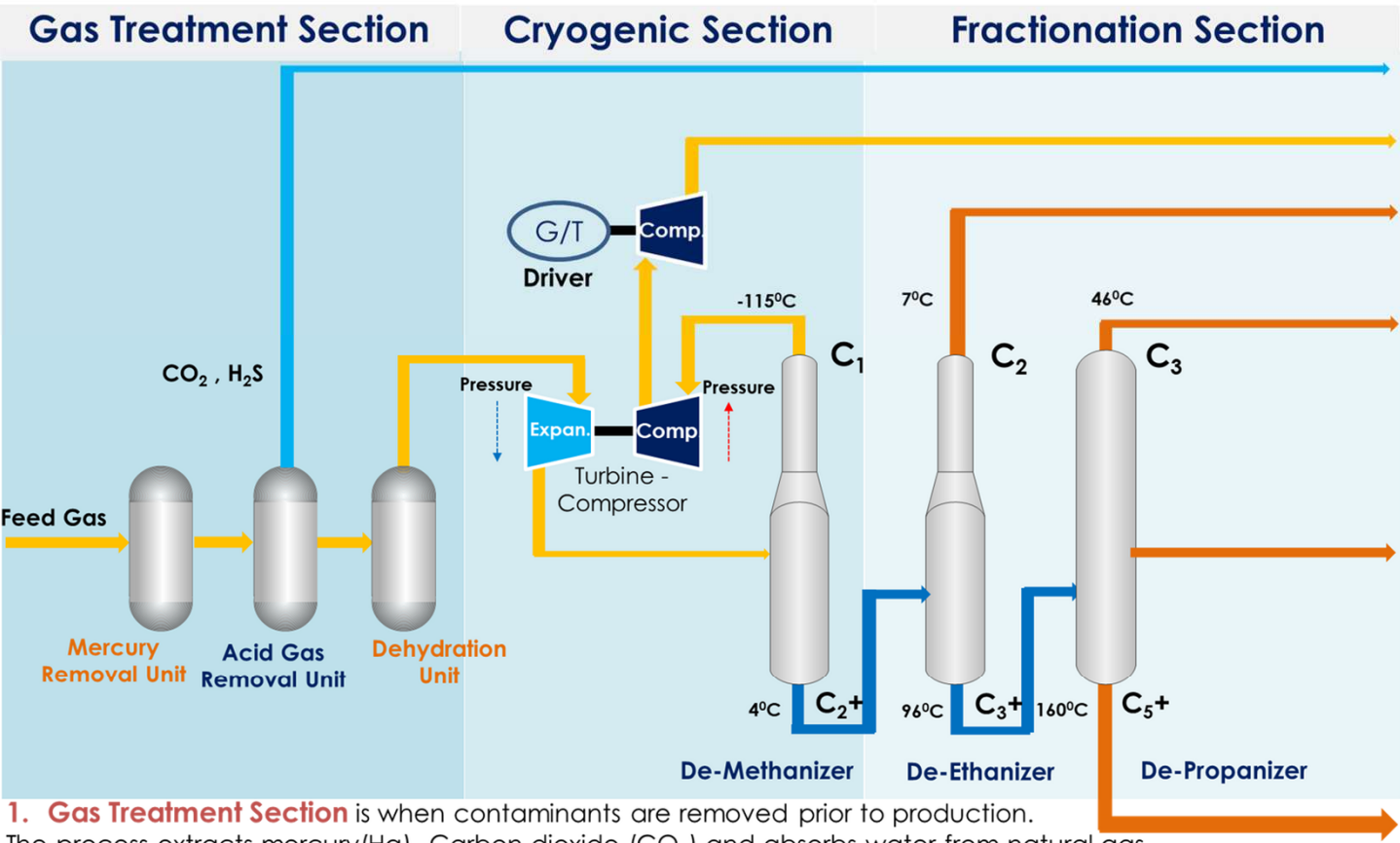
To manage and control natural gas quality
(Control Heating value of Natural gas to Power Plant)

3

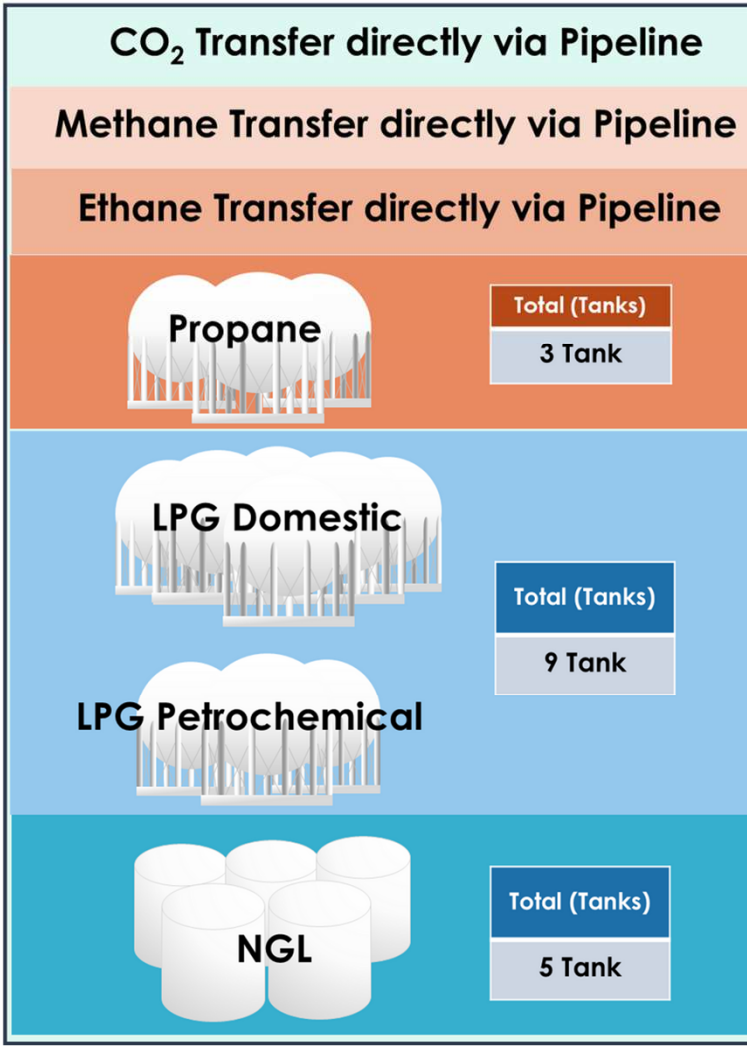
To create added value of natural gas
(Petrochemical)

5

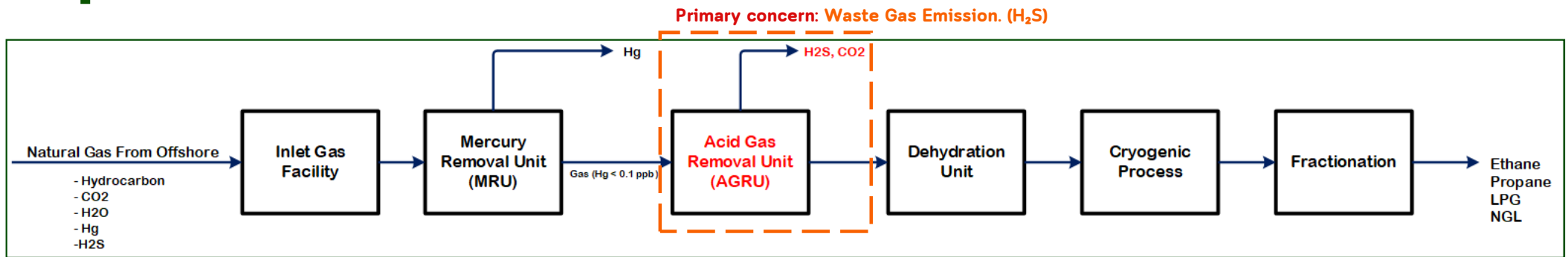
GSP'S PROCESS OVERVIEW



- 1. Gas Treatment Section** is when contaminants are removed prior to production. The process extracts mercury (Hg), Carbon dioxide (CO_2) and absorbs water from natural gas.
- 2. Cryogenic Section** greatly reduces the pressure and temperature of natural gas, converting it into liquid, Methane is separated in this session.
- 3. Fractionation Section** involves the use of the fractionation distillation process by which Ethane, Propane, LPG, NGL are separated at the boiling point of each product.



Environmental Problems Arising from Gas Separation Plants



Environmental Effects Caused by H_2S Emissions

Odor:

H_2S has a strong, foul odor detectable at very low levels, which is a major source of complaints in air pollution.

Environment impact:

H_2S is part of the sulfur cycle and can contribute to acid rain formation when oxidized to SO_2 .

EFFECTS OF H_2S EXPOSURE		
<1 PPM		Rotten Egg Smell
50 PPM		Irritated Eyes and Throat
100 PPM		Coughing and Headache
250 PPM		Difficulty Breathing and Vomiting
500 PPM		Loss of Balance
>750 PPM		Death Within Minutes



Solution to Waste Gas Emission from the AGRU Unit

To address the issue of H_2S emissions into the atmosphere from natural gas plants, the **ECO-PAG Project** has been implemented. This project effectively removes H_2S and helps reduce the environmental impact of harmful gases.

Ecological Purification Acid Off Gas (ECO-PAG)

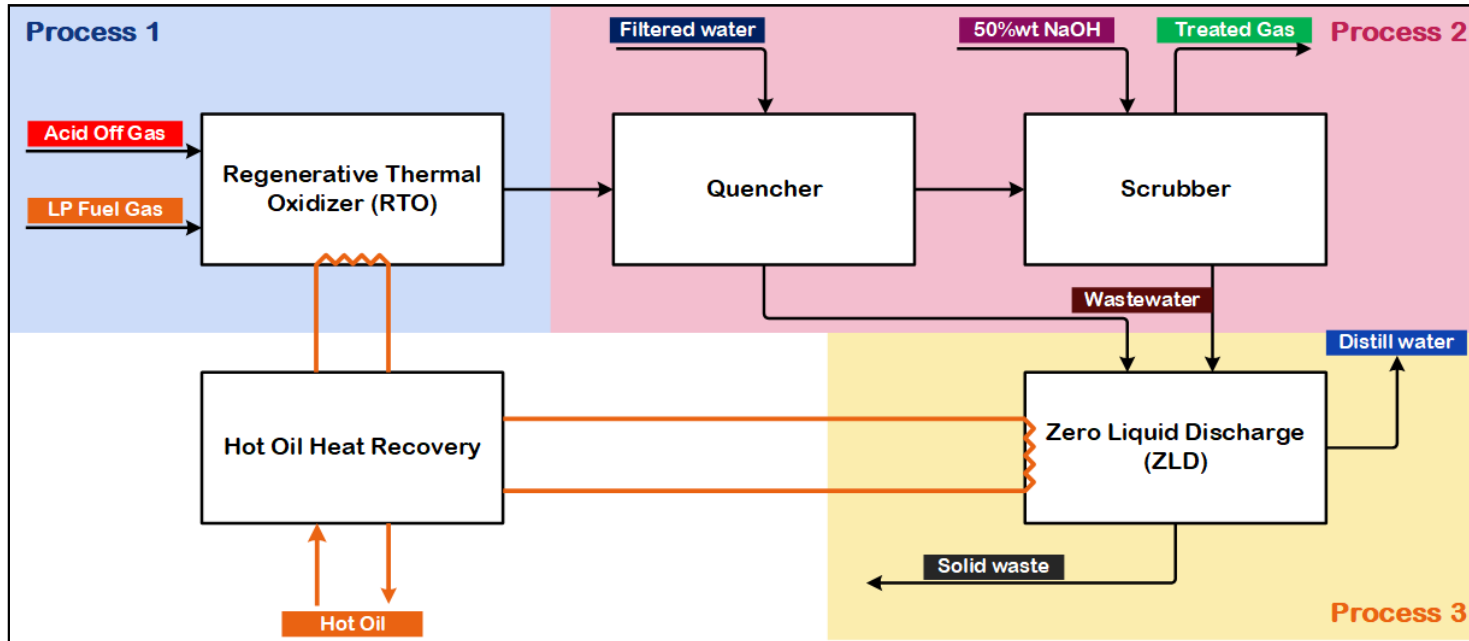


Figure 1 : Overview of ECO-PAG

Overview of ECO-PAG Project Components

The Ecological Purification Acid Off Gas (ECO-PAG) Project consists of three units:

- Regenerative Thermal Oxidizer (RTO)
- Quencher and Scrubber
- Zero Liquid Discharge (ZLD)

Main Components of ECO-PAG Project

Pollutant Gas Treatment Equipment

There are two types of available pollutant gas treatment equipment for selection in the ECO-PAG Project.

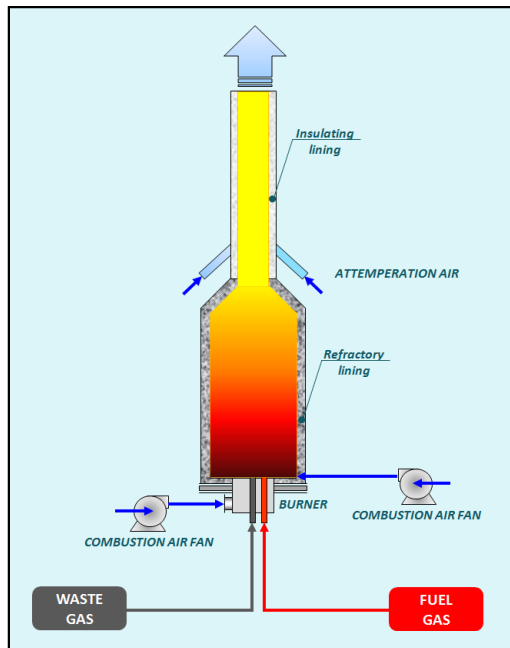


Figure 2 : Gas incinerator

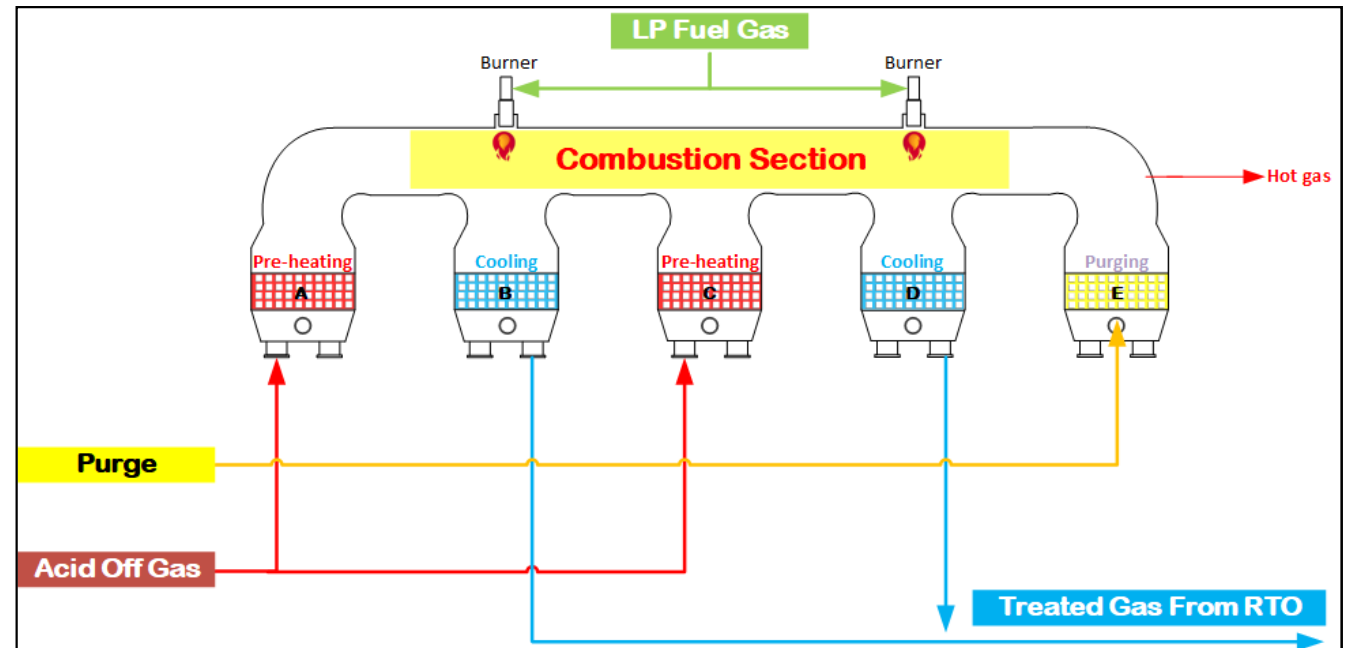


Figure 3 : Regenerative Thermal Oxidizer

Main Components of ECO-PAG Project

Pollutant Gas Treatment Equipment: Gas Incinerator

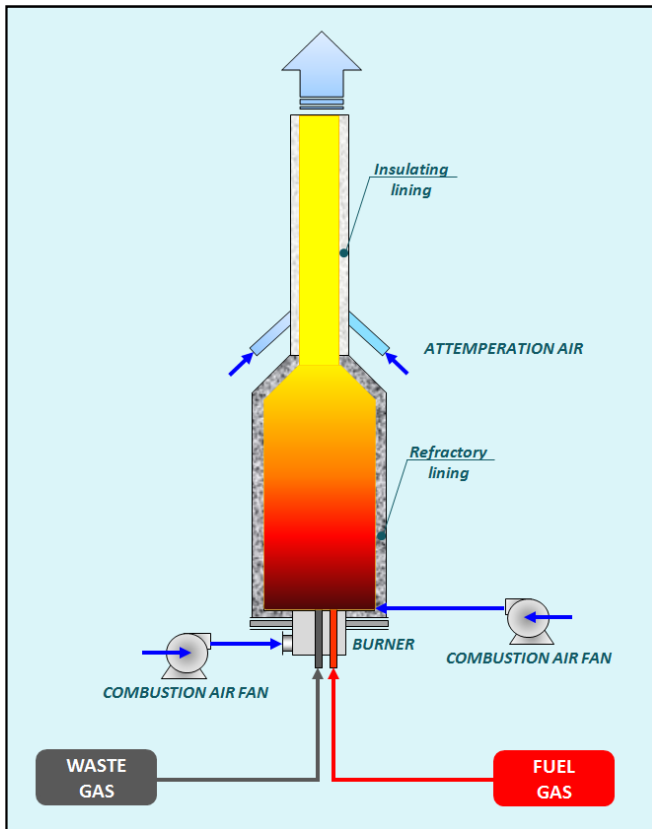


Figure 2 : Gas incenerator

Design and Operation of Gas Incinerator

Incineration of Gas in the Combustion Chamber:

- Waste gas is incinerated in a vertical chamber, retaining flue gas for 2 seconds at 850–950°C.
- Lined with refractory bricks and insulating castable, with a bottom burner and viewing ports.
- Platforms and ladders allow access to burners and sensors.

Operating Control:

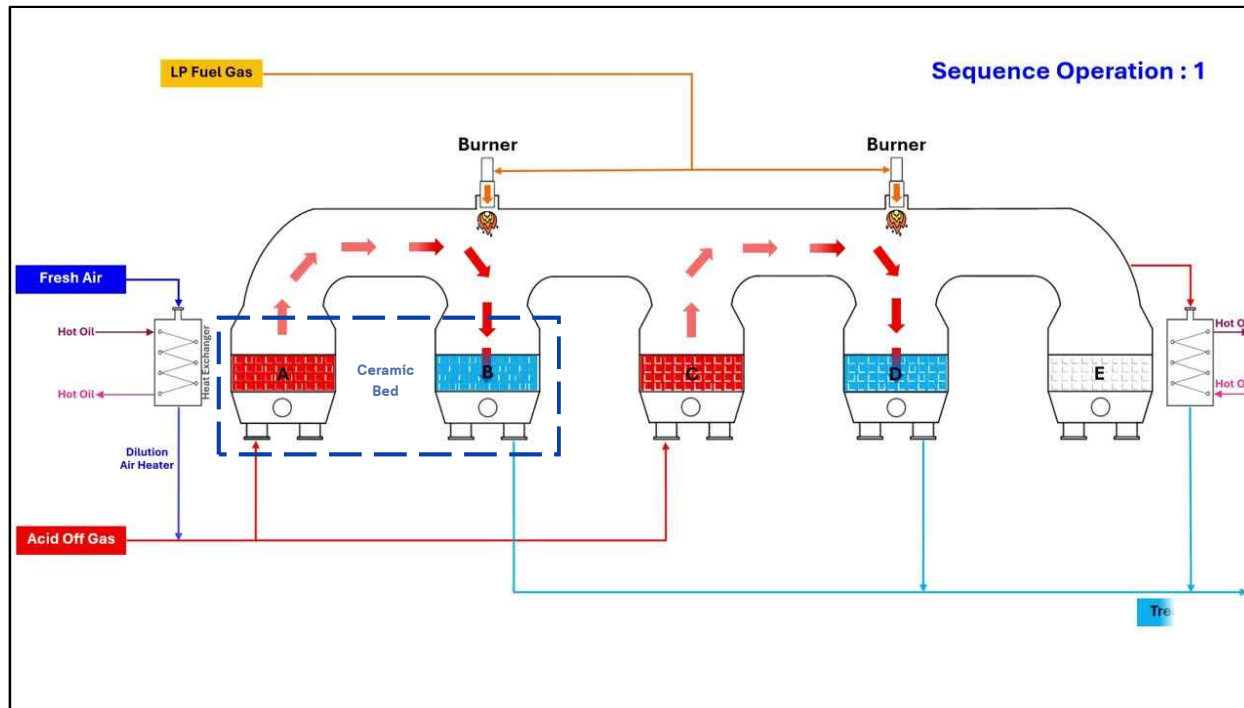
- Excess air is supplied by a centrifugal fan through a toroidal channel and multiple nozzles.
- Flame arrestors are installed to prevent backfire.

Temperature Control:

- Burner management system ignites, monitors the flame, and shuts valves on flame failure.
- Fuel gas heats the chamber during startup until the minimum temperature is reached, then waste gas is introduced.

Main Components of ECO-PAG Project

Pollutant Gas Treatment Equipment: Regenerative Thermal Oxidizer



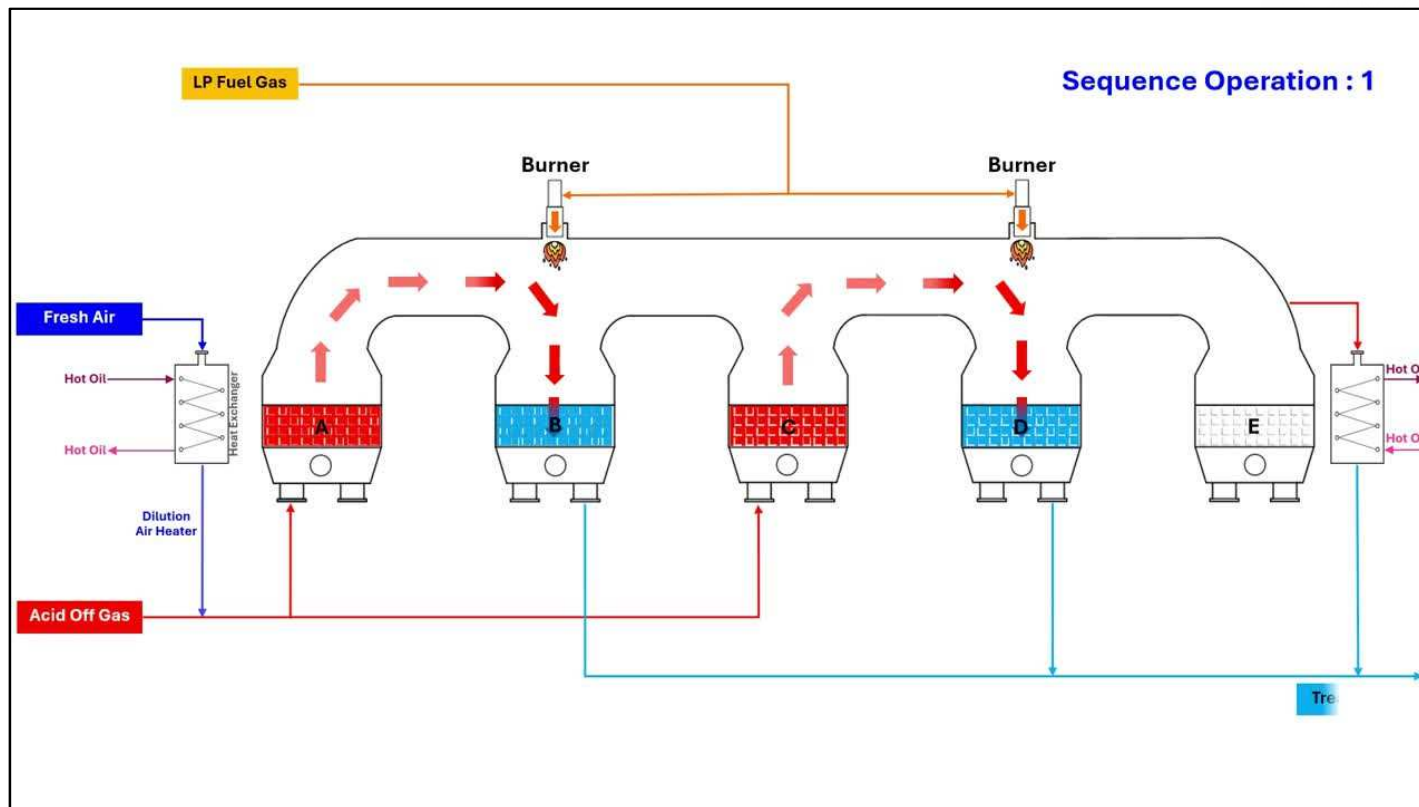
Video 1 : Regenerative Thermal Oxidizer

Advantages of Ceramic Layer

- **Heat Retention Efficiency:** Ceramic beds efficiently store and release heat, improving the combustion process and reducing fuel consumption.
- **Heat Recovery:** Ceramic beds help recover heat from the exhaust gases, reducing energy loss and allowing reused energy for other processes.
- **Energy Cost Reduction:** Heat recovery from ceramic beds lowers the energy needed for waste gas combustion, reducing operational costs. (30-70%)
- **Long Lifespan:** Ceramic beds are highly resistant to corrosion and high temperatures, leading to longer service life and reduced maintenance needs.

Main Components of ECO-PAG Project

Pollutant Gas Treatment Equipment: Regenerative Thermal Oxidizer



Sequence Operation

Each of the 5 chamber passes cyclically through three phases :

- Preheating phase
- Cooling phase
- Purging phase

Each cycle of operation is like the previous one, so the outline is repeated the same each time.

A and C: preheating B and D: cooling E: purge
A and D: preheating B and E: cooling C: purge
B and D: preheating C and E: cooling A: purge
B and E: preheating A and C: cooling D: purge
C and E: preheating A and D: cooling B: purge

Video 1 : Regenerative Thermal Oxidizer

Main Components of ECO-PAG Project

Comparison of Two Types of Pollutant Gas Treatment Equipment

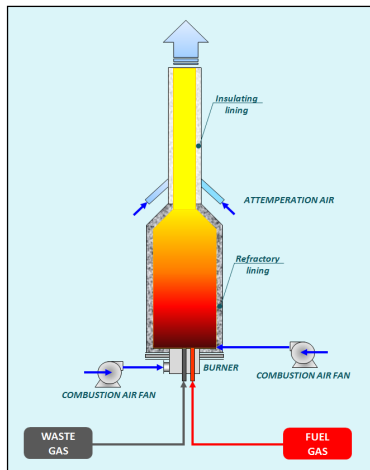


Figure 2 : Gas incinerator

Comparison Table between Incinerator and Regenerative Thermal Oxidizer

	Incinerator	Regenerative Thermal Oxidizer
Heat recovery rate	60%	95%
Running cost	High	Low

Energy consumption is reduced by approximately 58% when comparing the Incinerator and RTO, with the RTO having a higher heat recovery rate than the Incinerator.

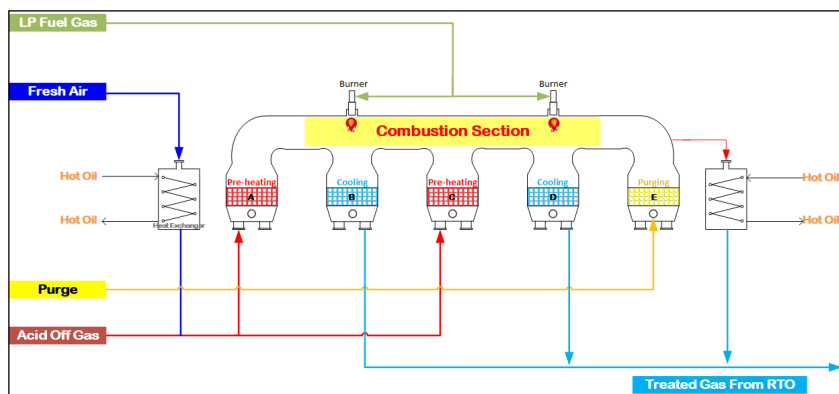


Figure 3 : Regenerative Thermal Oxidizer (RTO)



Due to the **use of a ceramic bed** for energy recovery from exhaust gases, the RTO is able to reduce fuel consumption for subsequent operations.

Main Components of ECO-PAG Project

Two Types of Zero Liquid Discharge

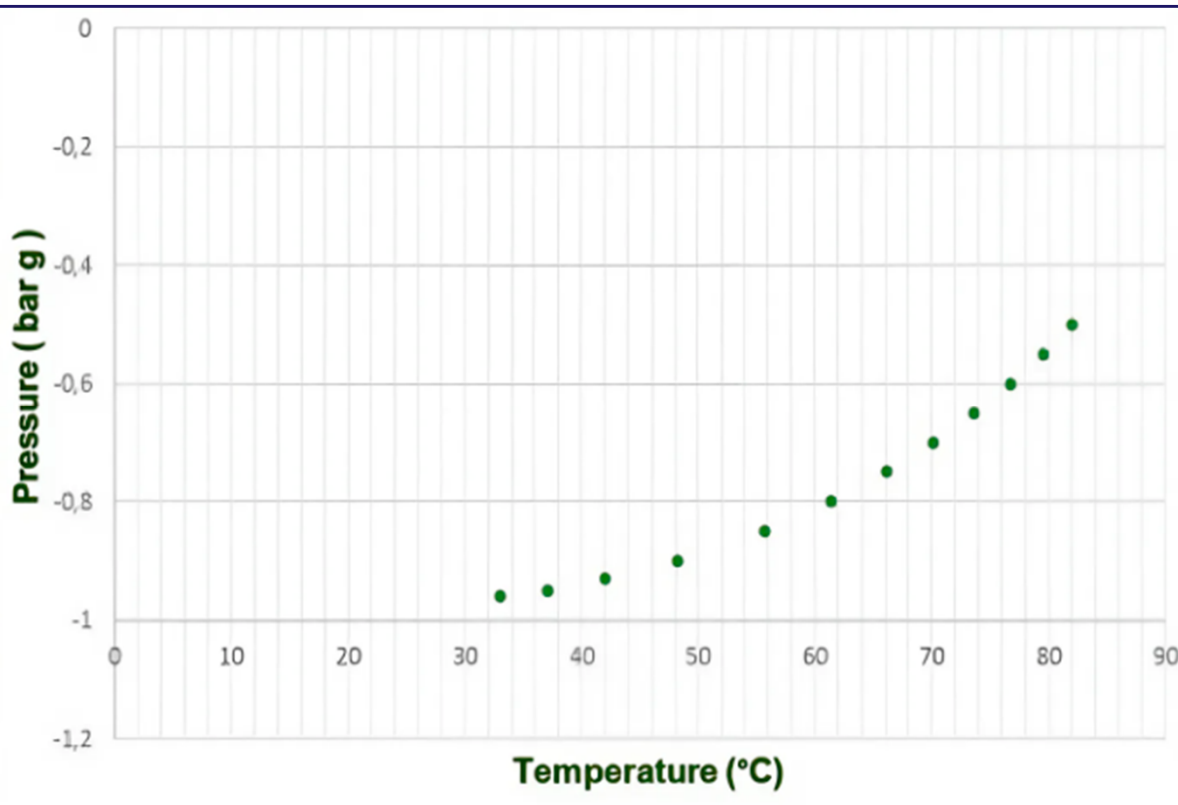


Figure 4 : Relationship between Pressure and Boiling Point

In the ECO-PAG Project, two types of evaporators are available for selection in the Zero Liquid Discharge (ZLD) process.

Atmospheric Evaporator

Boiling point (Tbp) = 100°C

Vacuum Evaporator

Boiling point (Tbp) = 30 - 50°C



The vacuum evaporator system can **reduce energy consumption by 5 to 10 times** compared to the atmospheric evaporator, depending on the design and technology used.

Main Components of ECO-PAG Project

Principle of Zero Liquid Discharge

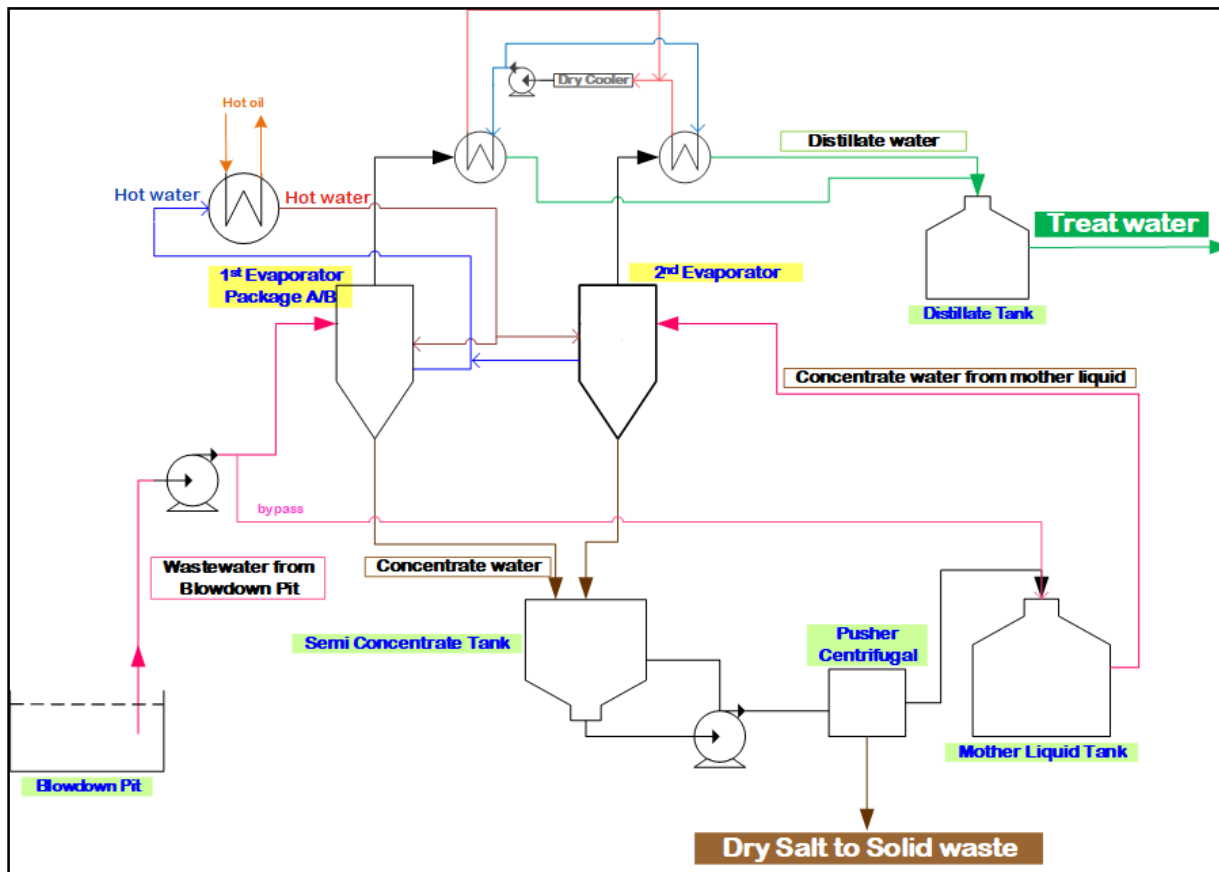


Figure 5 : Zero Liquid Discharge

1st Evaporator package A/B

- The wastewater is boiled using 80°C hot water, evaporating excess water and increasing the concentration of dissolved substances.

Semi Concentrate Water

- A concentrated solution is mixed to prevent salt precipitation and clogging.

Pusher Centrifugal

- To separate the concentrated solution into mother liquid and dry salt.

2nd Evaporator

- The mother liquid from the Mother Liquid Tank is sent to the 2nd Stage Evaporator Package for water evaporation.

Waste Heat Recovery Concept in ECO-PAG Project

Hot gas from the Regenerative Thermal Oxidizer

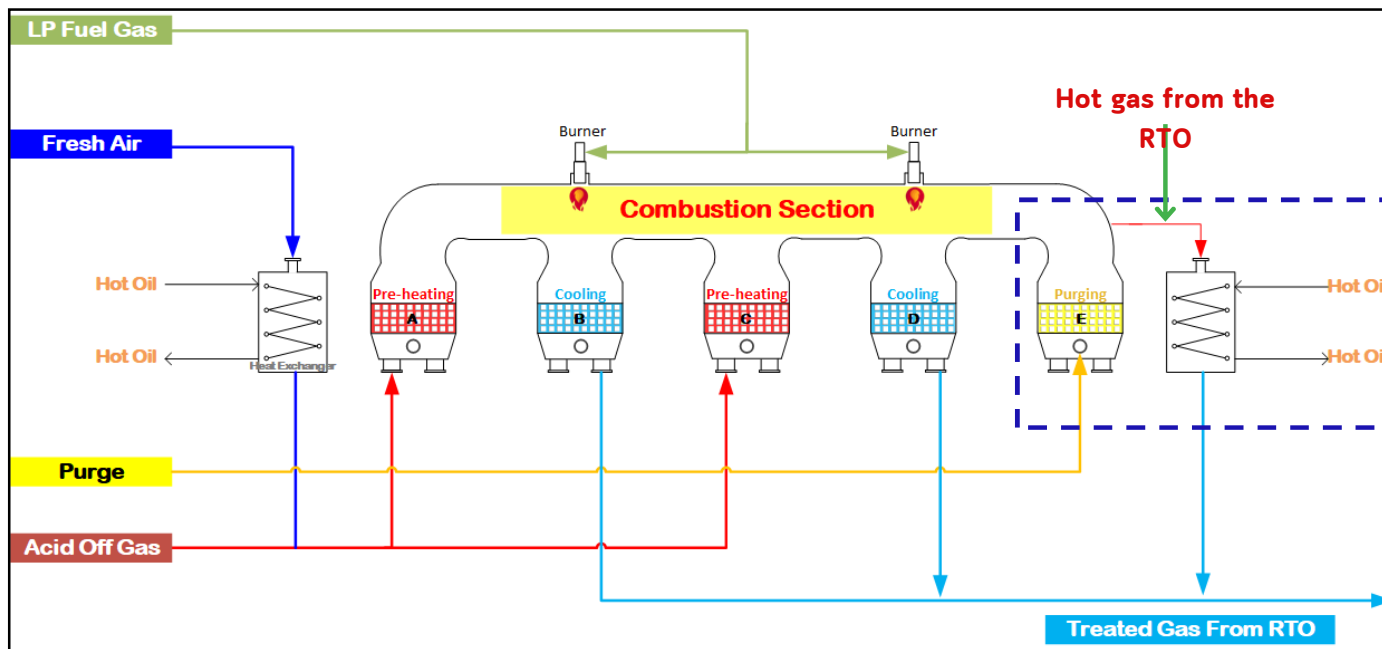


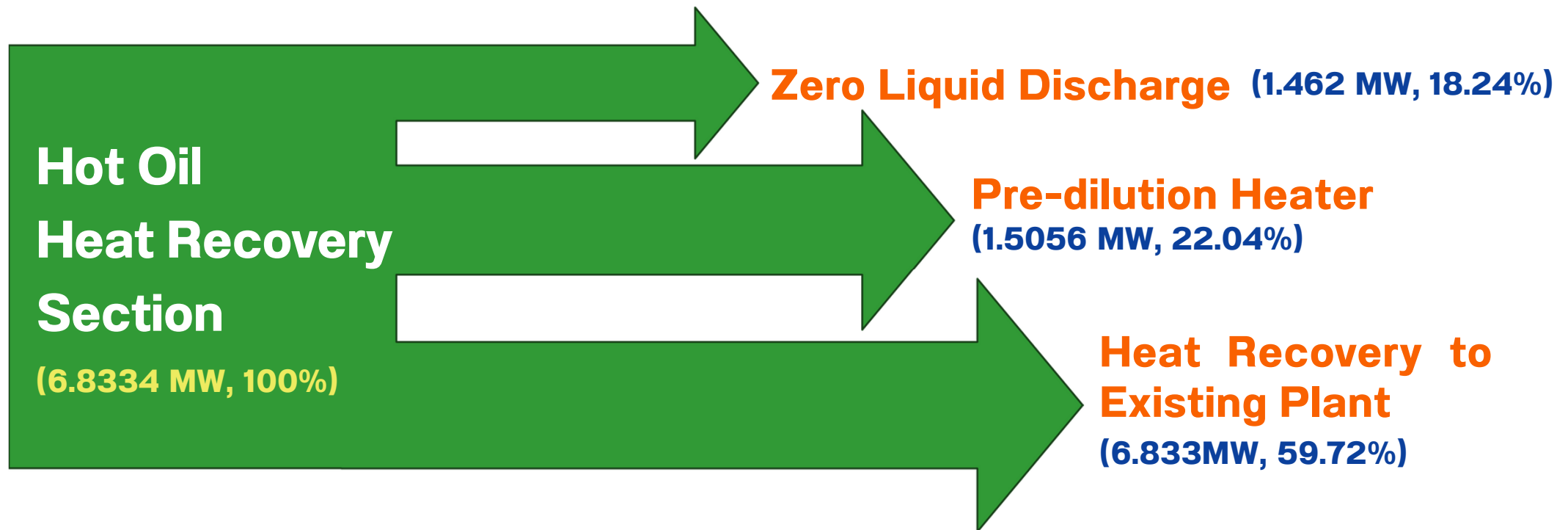
Figure 3 : Regenerative Thermal Oxidizer

Hot gas from the Regenerative Thermal Oxidizer

Approximately 10% of the exhaust gas from the Regenerative Thermal Oxidizer at a temperature of 800-850°C will flow into the heater to exchange heat with hot oil, raising its temperature from 130°C to 170°C.

Main Components of ECO-PAG Project

Application of Heat Recovery Section



Conclusion

Advantages of Selection Pollution Control Equipment

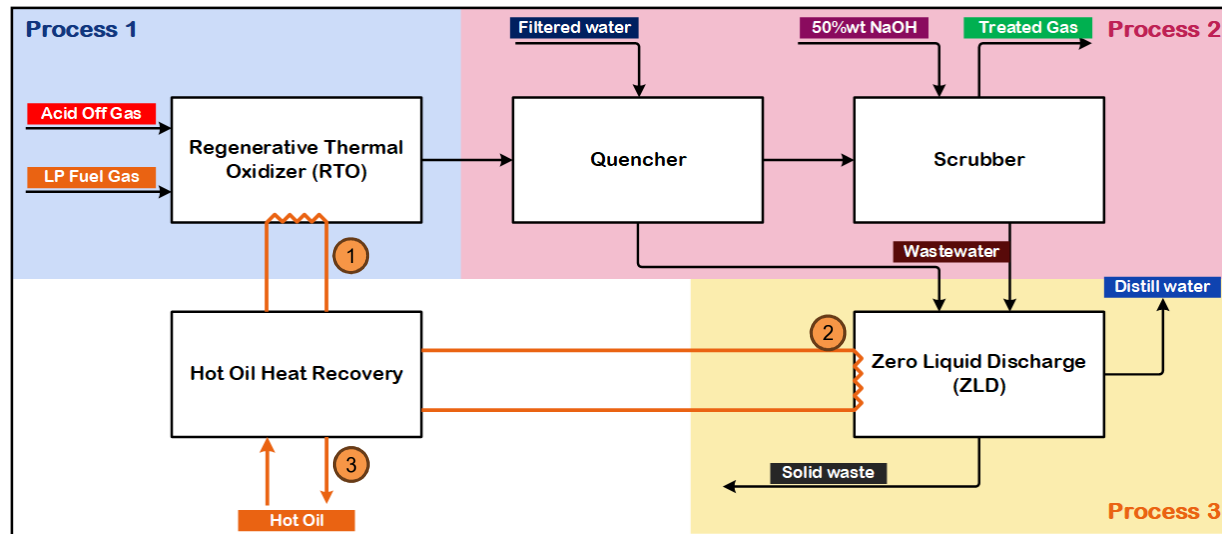


Figure 6 : Overview of ECO-PAG

User Integration for Heat Recovery Section

- ① Pre-dilution Heater
- ② Zero Liquid Discharge
- ③ Heat Recovery to Existing Plant

Energy Savings:

due to

- RTO recycles heat.
- Vacuum Evaporator operates at lower temperatures.

Cost Reduction:

Both reduce energy and operational costs due to

- Vacuum Evaporator cuts waste disposal costs.
- RTO reduces fuel and maintenance costs.

Environmental Impact:

Both reduce emissions due to

- RTO burns pollutants efficiently.
- Vacuum Evaporator reduces liquid waste and aids water conservation.



Thank You For your attention



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