



Society of Petroleum Engineers



# Gas Field Development and Production – State of Play

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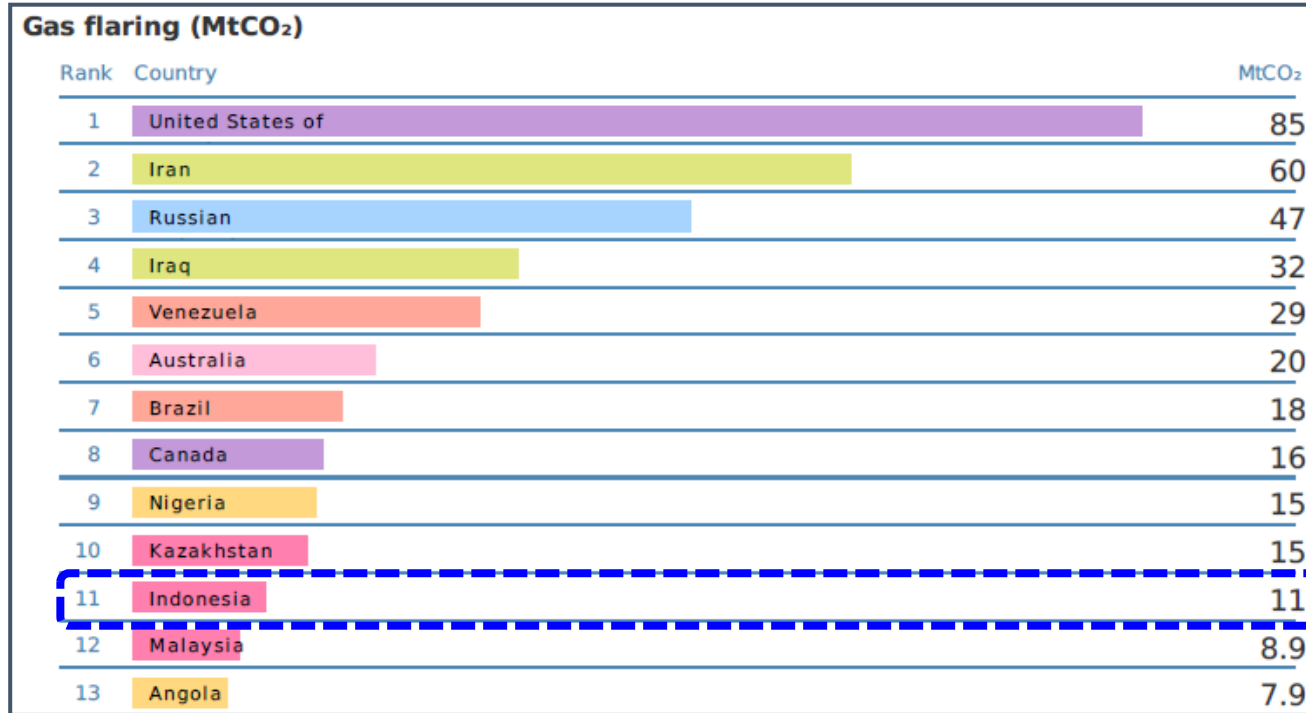
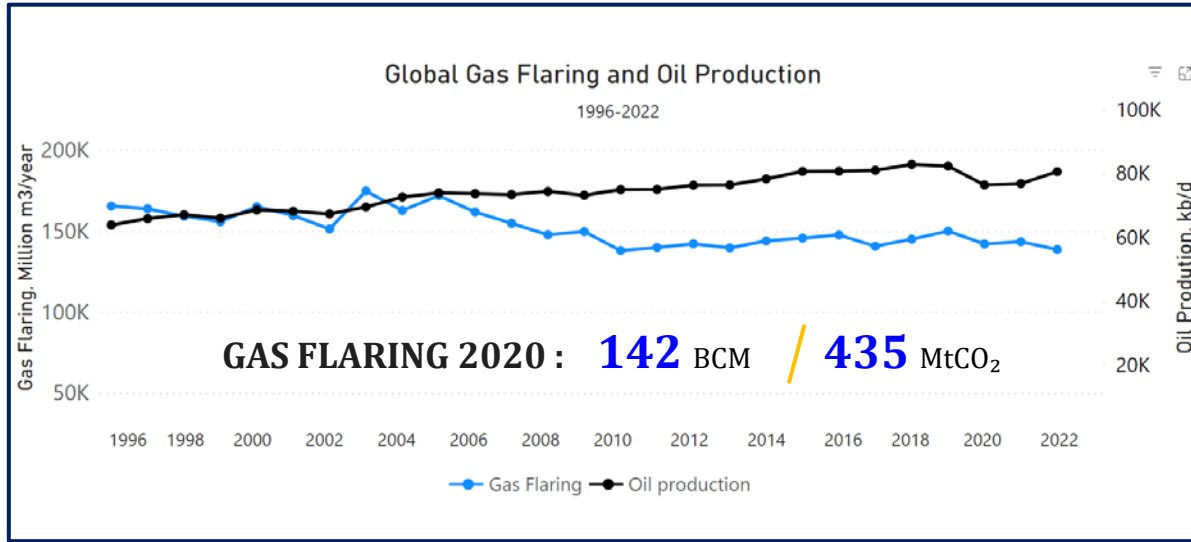
15 – 16 January 2024 | BANGKOK, THAILAND

# Decarbonization Strategy Using Extended Vacuum Entrainment Ejector to Recover Un-used Flare Gas

Agus Eko Setyono



# Global Gas Flaring



*Gas flaring is defined as the “controlled burning of gases that cannot be processed for sale or use because of technical or economic reasons.” Source: world bank, 2022*

*Company's commitment*

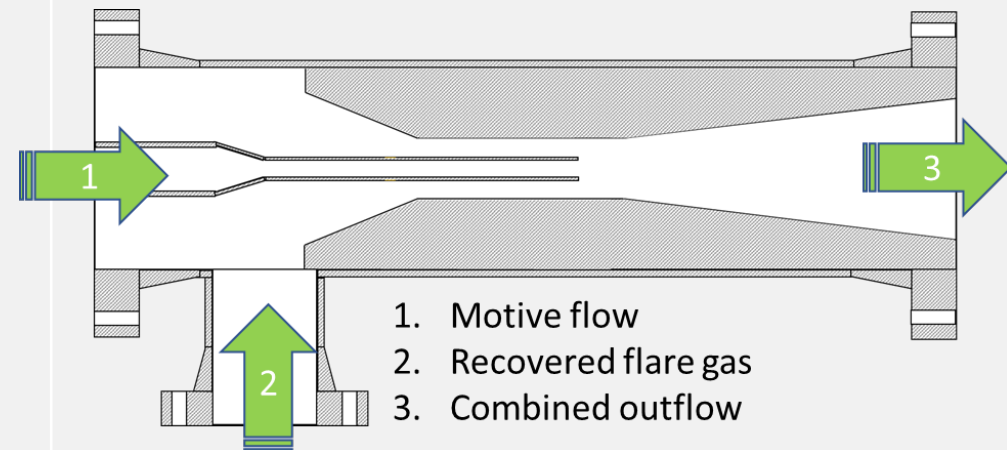



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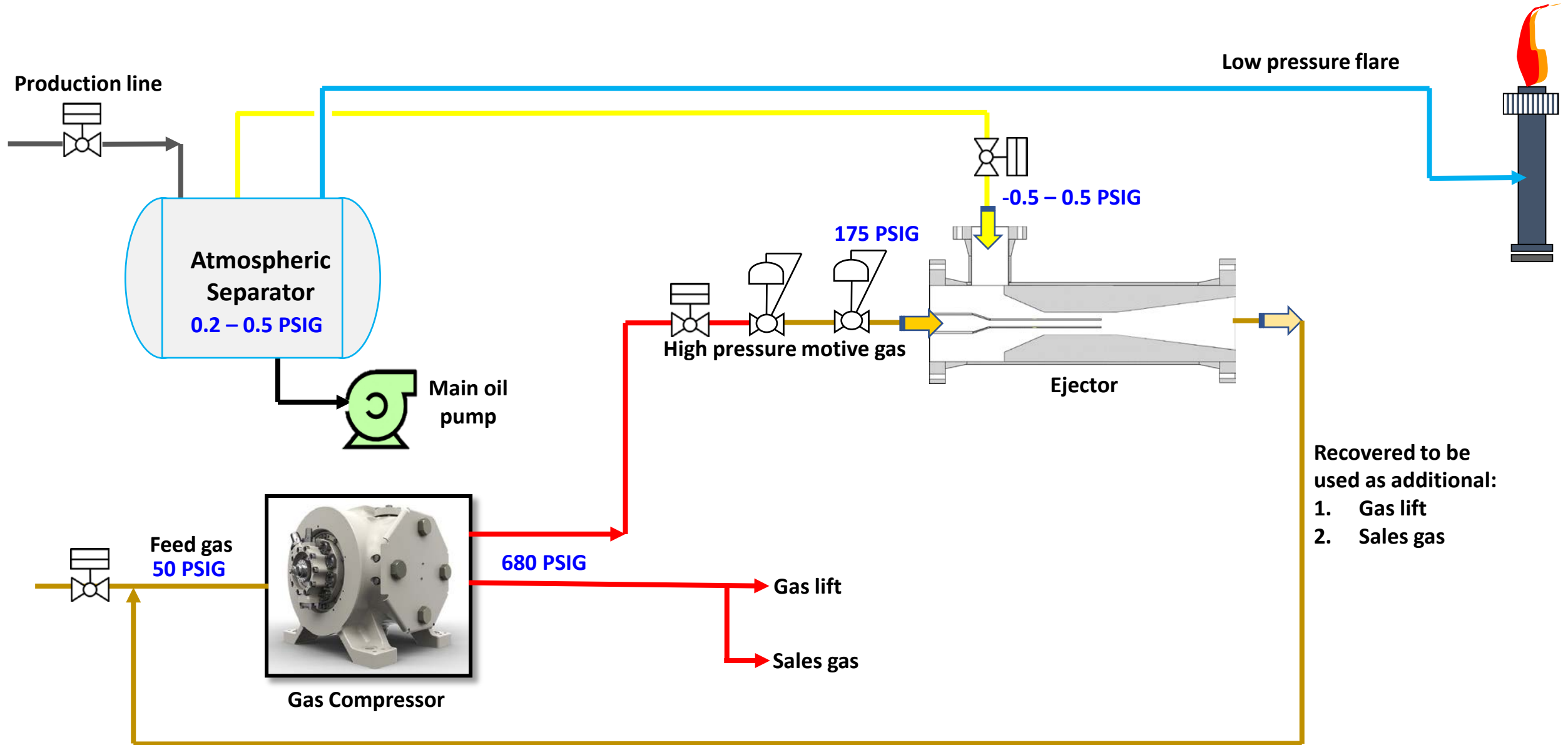
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**TASKFORCE SUSTAINABILITY EMISSION**  
**REDUCTION DI ZONA 5**  
**2022-2023**

# Flare Gas Recovery

No	Aspect	Vapor recovery unit	Extended Vacuum Entrainment (EVE) - EJECTOR
1	Cost	> US\$ 1M – 2M	US\$ 50K – 150K
2	Stand by operator	2 operators	-
3	Production Stability	High	High
4	Facility modification	Major	Minor
5	Working system	Auto and Continuous	Auto and Continuous

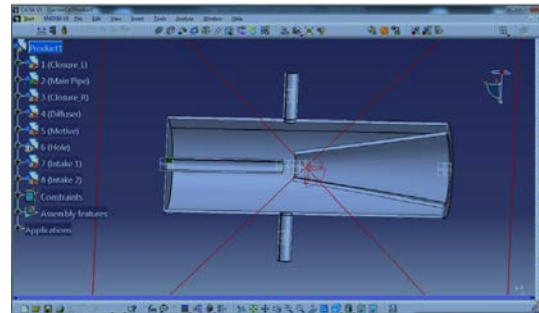
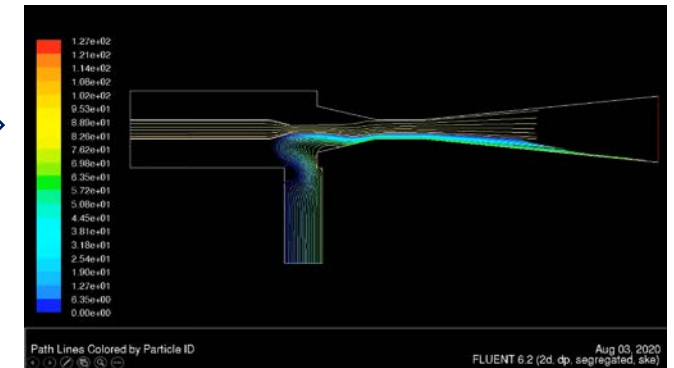
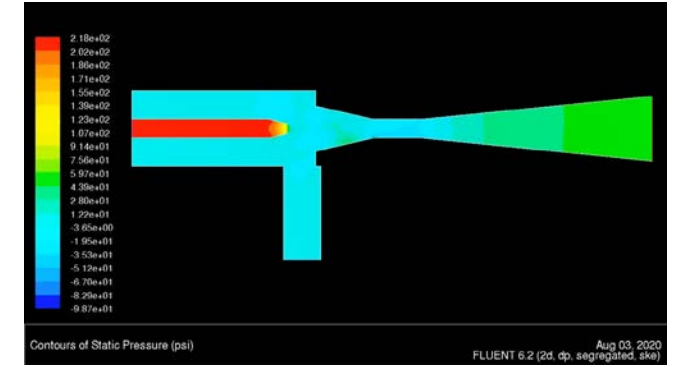
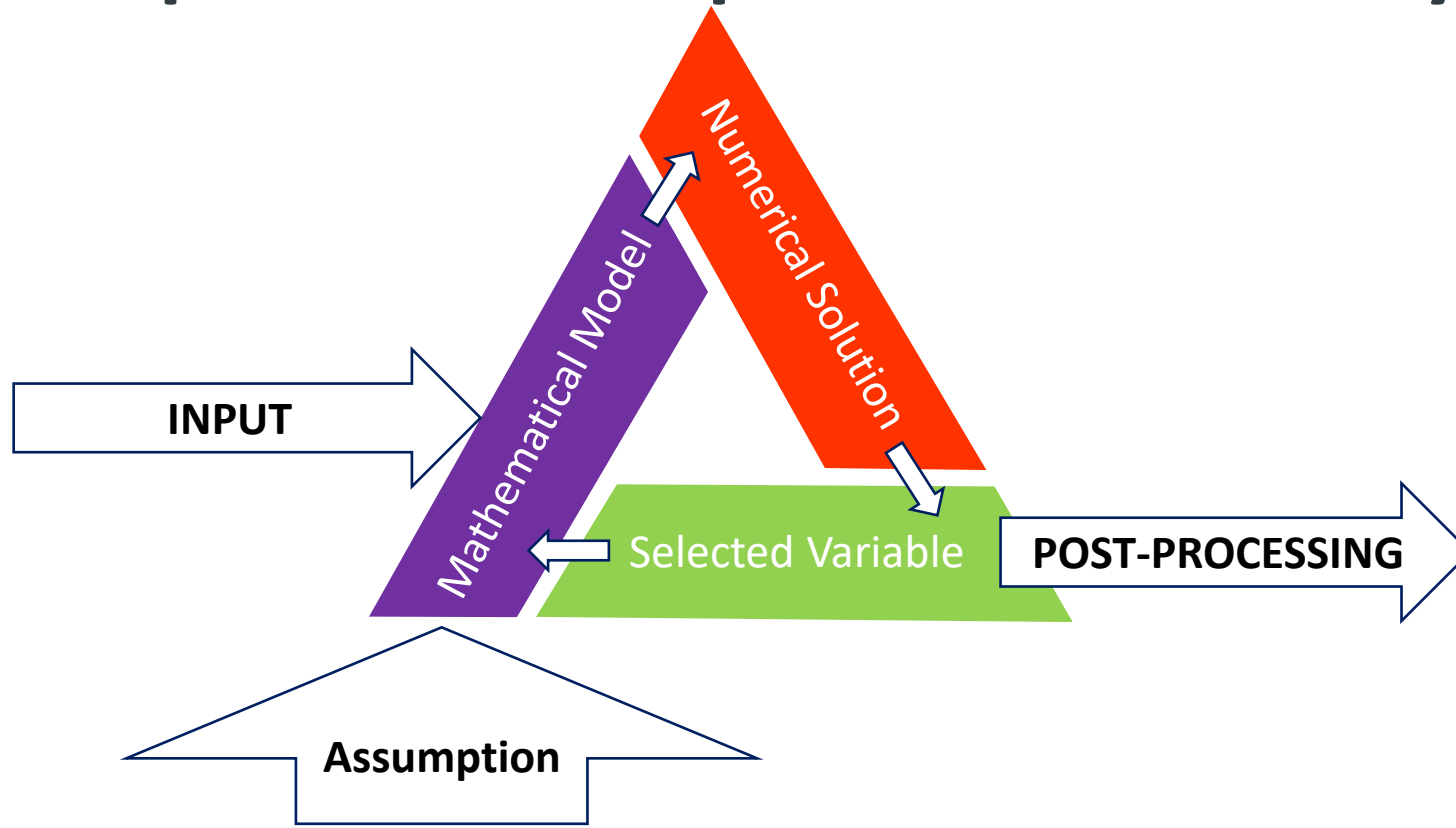


# Process Flow Diagram





“SI HULU”



Physical Problems

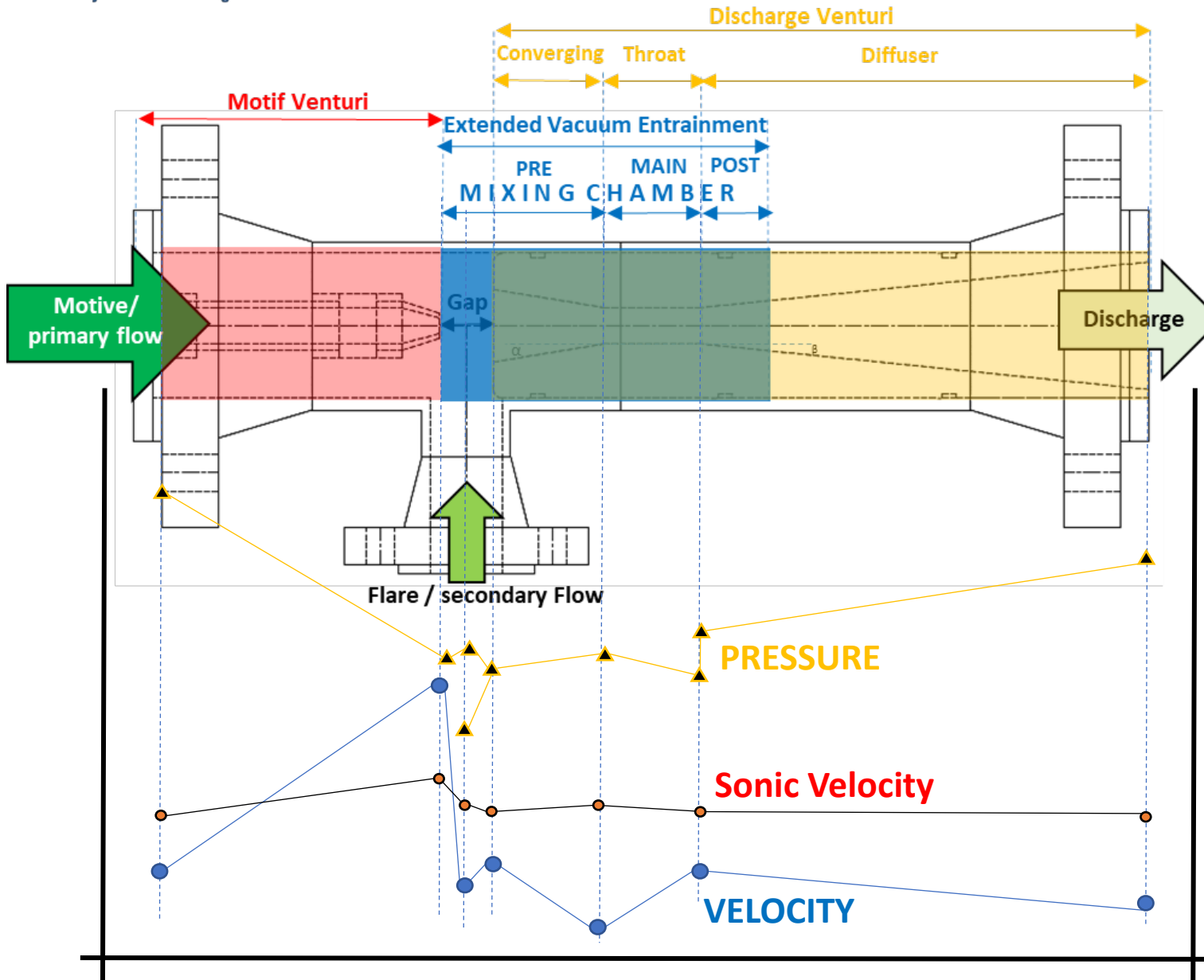


1. Hand Calculation
2. Experimental Data

CFD basis refers to **ASME V & V 20-2009 Standard for Verification and Validation in Computational Fluid Mechanics and Heat Transfer**

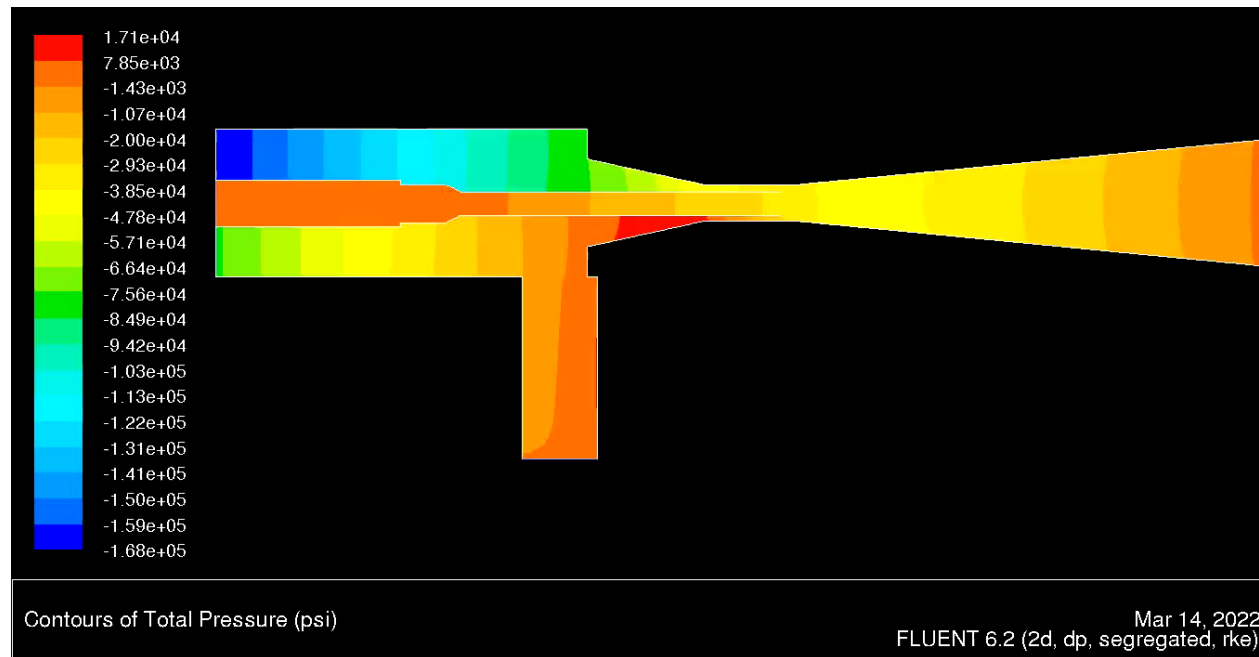


# EVE-Ejector Fun Fact's



1. Vacuum efficiency = 61.67%
2. Evacuation time of mixed fluid flow inside ejector = 0.02290 second
3. The highest MACH number = 2.155
4. The lowest MACH number = 0.03936
5. Throat ratio of  $\text{Throat}_{\text{length}} / \text{Throat}_{\text{diameter}}$  is 2.6

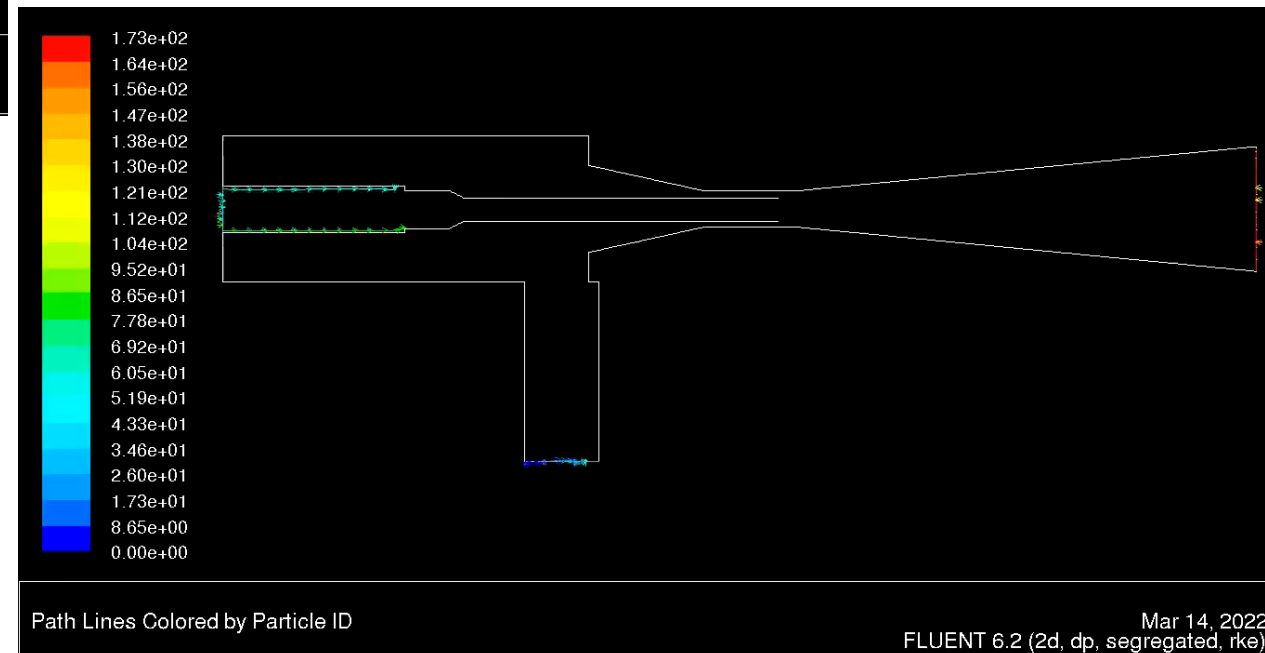
# Simulation Results



1. EVE phenomenon occurred along:
  - primarily at motive nozzle exit
  - secondarily at diffusion chamber
  - tertiary at throat zone
2. Secondary inlet is designed to overcome  $\text{Flow}_{\text{secondary}}/\text{Flow}_{\text{primary}}$  from 0.13 to 0.45
3. No adverse pressure gradient prior to diffusing chamber

4. At diffuser, an angle  $\beta$  of  $5.5^\circ$  quite robust to cope with residual turbulence kinetic energy

5. Turbulent kinetic energy is able to be minimized gradually in order to blend primary and secondary stream flow





## Recovered Gas from Atmospheric Separator



Commissioning has been conducted from 16 – 23 September 2022 overnight under pressure conditioning at Atmospheric Separator up to 0.5 PSIG. Gas metering unit only able to capture 3 days data log under logging interval of 60s.

# Flare Gas Recovery Result

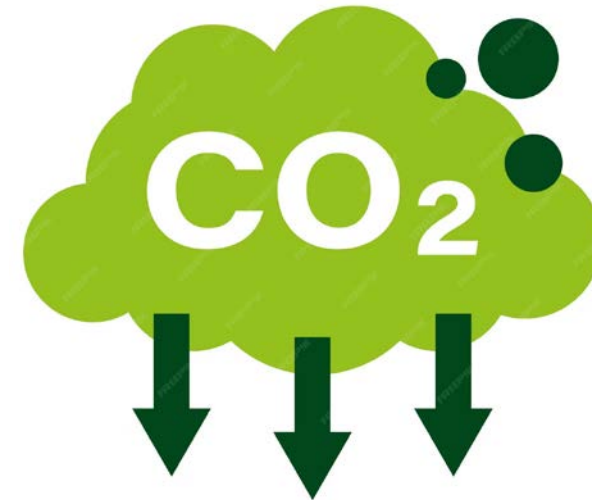
*Period: 8 Feb – 30 Nov 2023*

*(295 days Ejector online)*

During 9 months operation, this solution has successfully attracted 5,261 MSCF equals with reduce CO<sub>2</sub> emissions by 351.15 ton CO<sub>2</sub>eq. To be aligned with sustainable energy efficiency and conservation program, enhanced-ejector is denominated as green-low-cost solution.



**5,261 MSCF ~ 72,600 USD**



**351.15 ton CO<sub>2</sub>eq**