



CCOP – PETRAD – PETROVIETNAM EPPM P2W3: Workshop on the Use of CO₂ for IOR/EOR and Gas Hydrates
as Potential Energy Source

Da Nang 8th -11th Dec 2009



Development of natural gas fields with high CO₂ in Vietnam

PetroVietnam



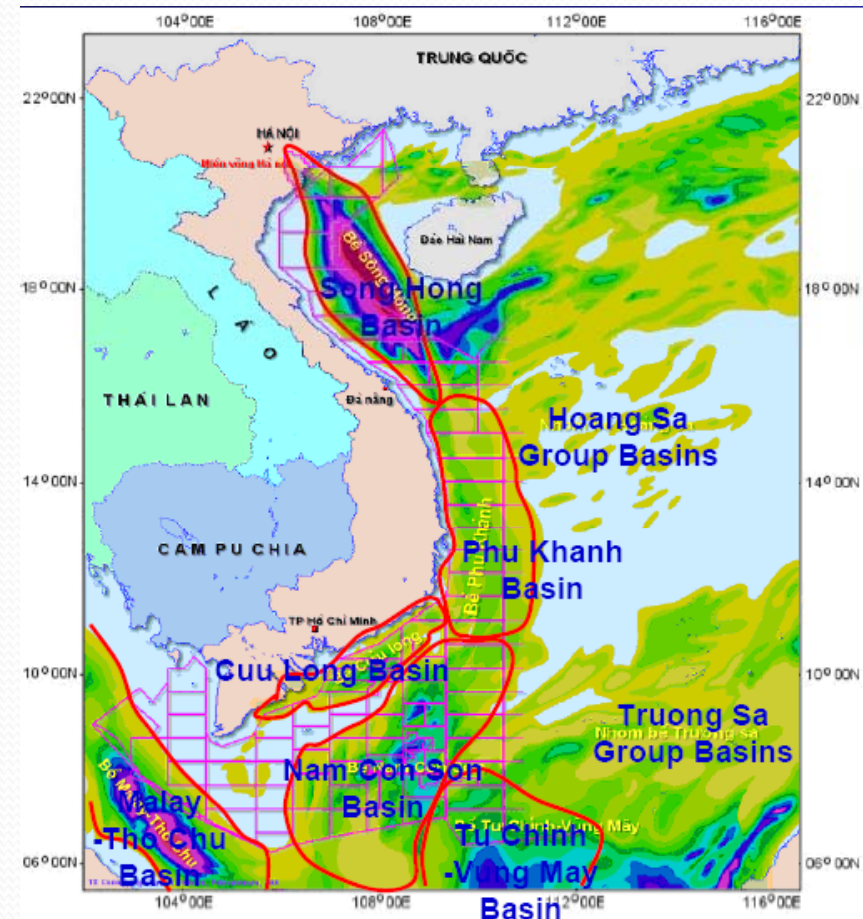
Contents

- Vietnam gas demand and supply
- A case study
- CO₂ application for EOR
- Conclusions

Vietnam Oil and Gas Sedimentary Basins

8 identified sedimentary basins

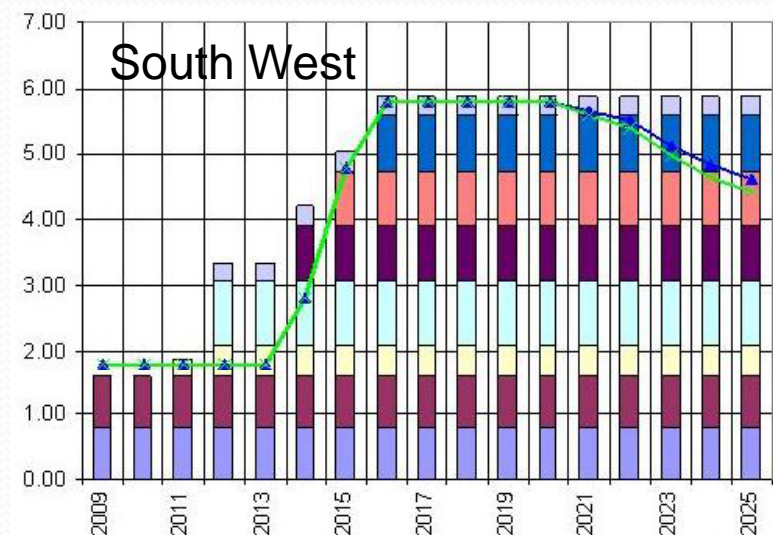
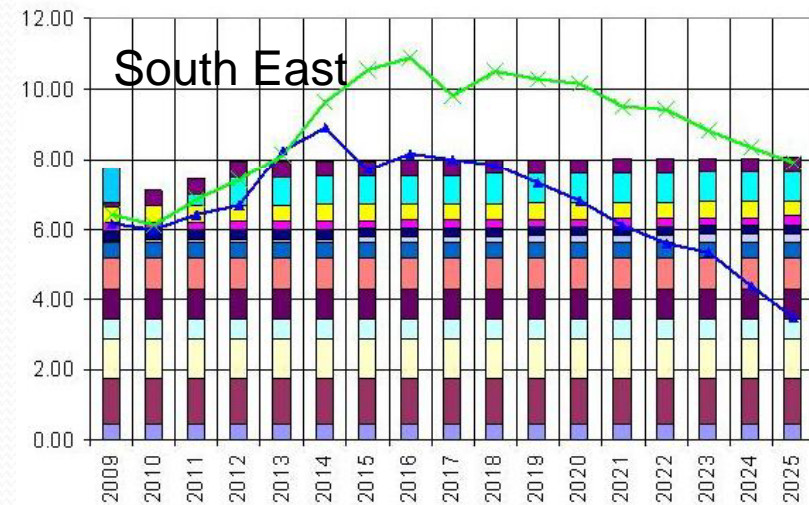
- Song Hong
- Phu Khanh
- Cuu Long
- Nam Con Son
- Malay-Tho chu
- Tu Chinh-Vung May
- Hoang Sa & Truong Sa group of basins





Vietnam Gas Supply and Demand

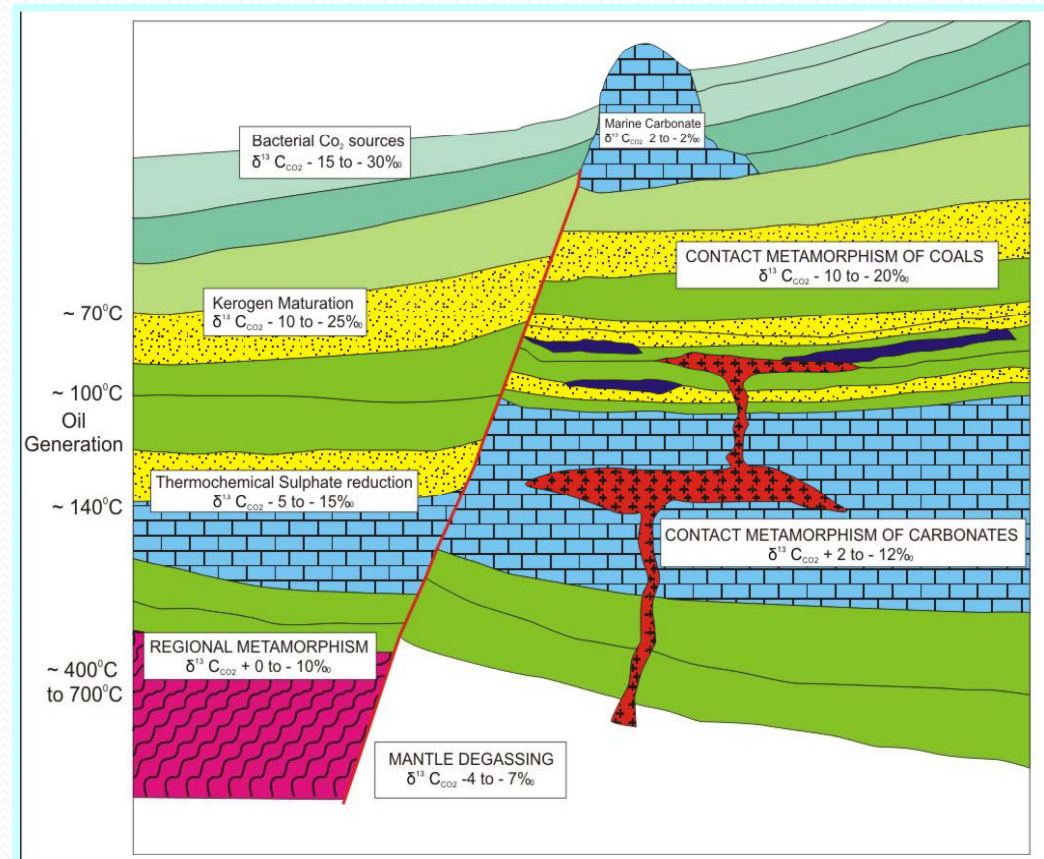
- Current gas production is ~ 800 MMcfd. The supply includes clean and CO₂ gas
- Gas consumption: 88% for power generation, 7% for fertilizer, 5% for others
- Gas demand is very high and always far above supply
- Gas supply may not meet the demand in the future
- One of the solutions: Gas fields with high CO₂ - potential but also challenges



CO₂ Possible sources

CO₂ Possible Origin

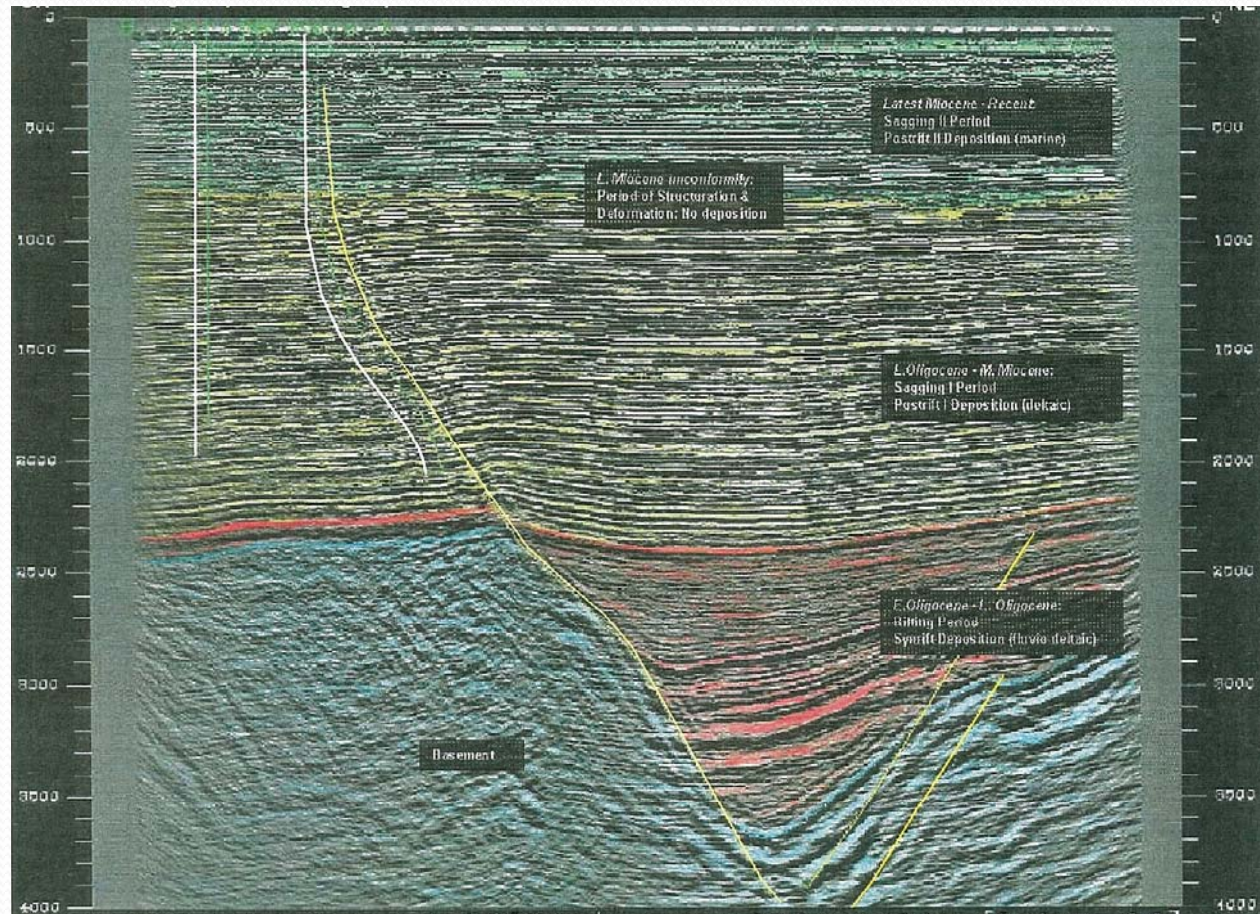
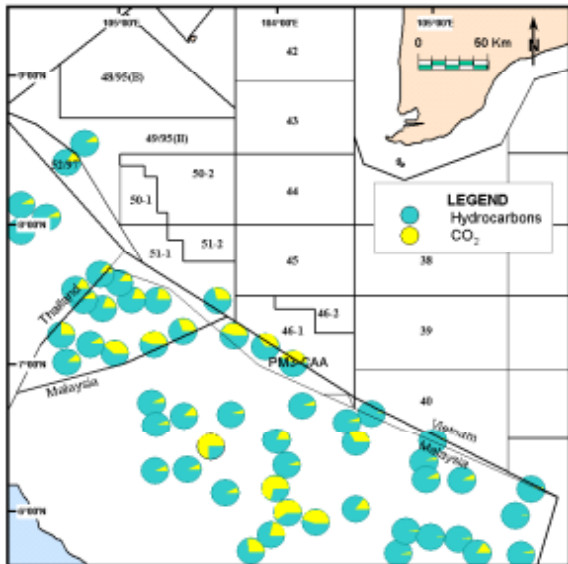
- Marine Carbonate
- Bacterial CO₂ sources
- Kerogen Maturation
- Contact Metamorphism of Coals
- Thermochemical Sulphate Reduction
- Contact Metamorphism of carbonates
- Regional Metamorphism
- Mantle degassing





A case study

- Gas fields of PM3 CAA Complex





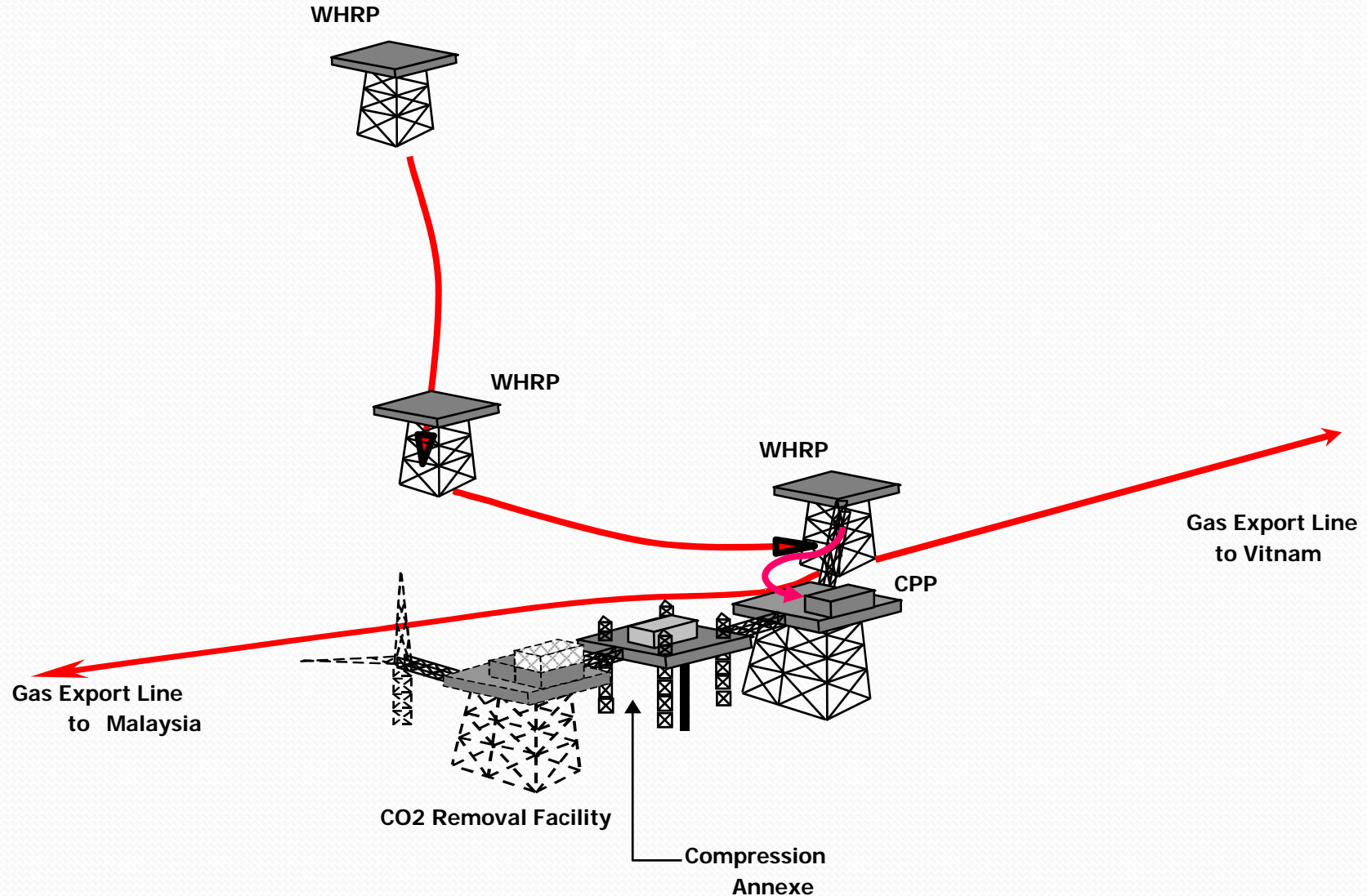
Gas fields of PM3 CAA Complex

Gas Main Parameters:

- CO₂ content: 16% - 66%, average 40%
- H₂S content: 0 – 54 ppm.
- Hg content: to 130 µg/m³ (Sales Gas limit is 20 µg/m³)



Gas fields of PM3 CAA Complex





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Gas fields of PM3 CAA Complex



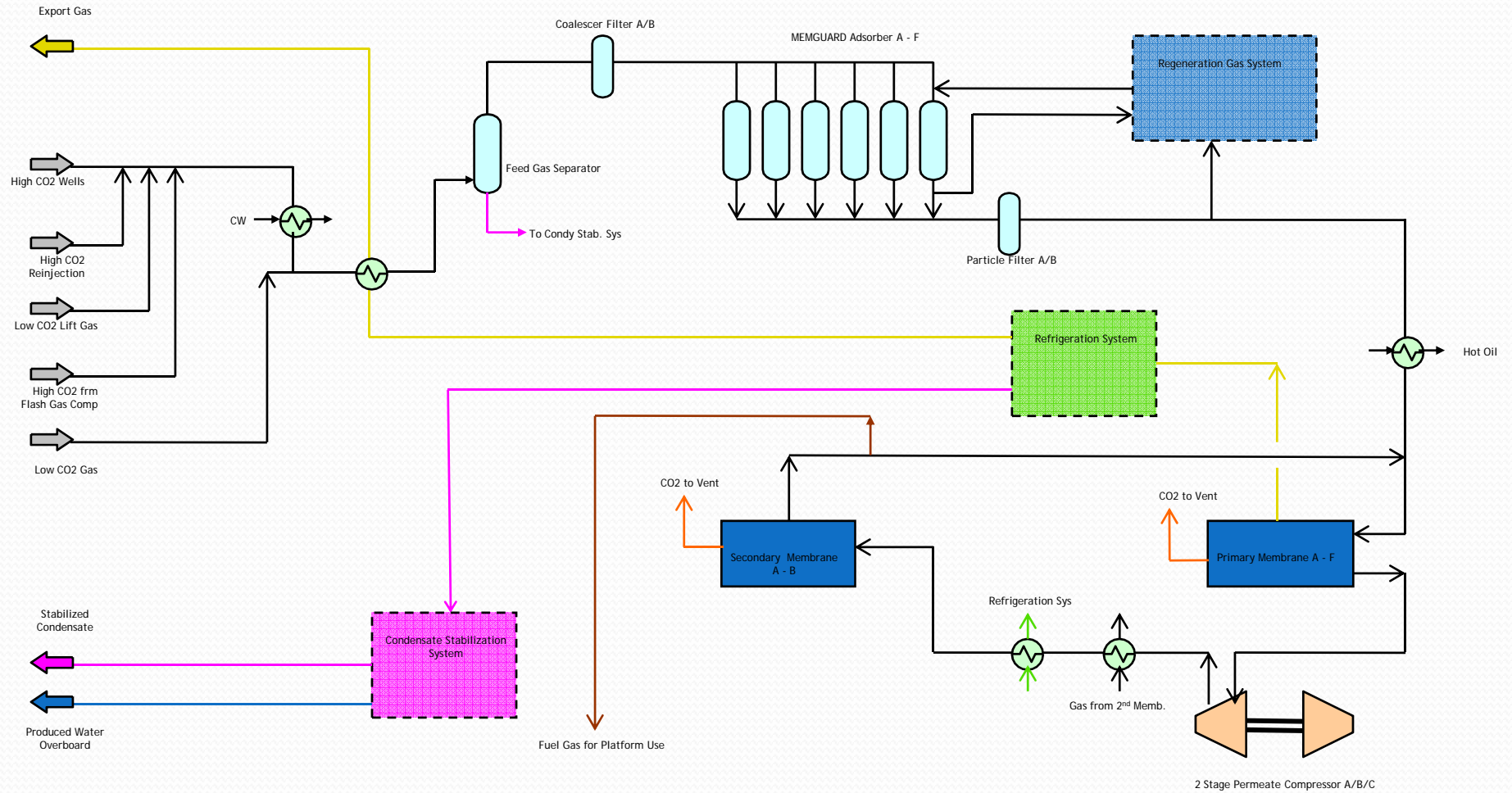


Processing before GPP

- Primary Facilities: dehydration is important
 - Highly corrosive gas containing typically 40% CO₂.
 - Removal of water to reduce the gas water dew point avoiding CO₂ corrosion of the carbon steel pipeline.
- Future Facilities: Mercury removal



GPP layout





Pre-treatment

- Pretreatment unit consists:
 - **Feed /Export Gas Exchanger**
 - **Feed Gas Separator**
 - **Filter Coalescers**
 - **Memguard**
 - **Particle Filters**
 - **Membrane Pre-Heater**



Pre-treatment

- Pretreatment section is vital for the membrane unit by removing aerosols, particulates and impurities.
- Pretreatment section also delivers the clean, dry feed gas to the membrane unit at the desired temperature to maximize membrane performance.



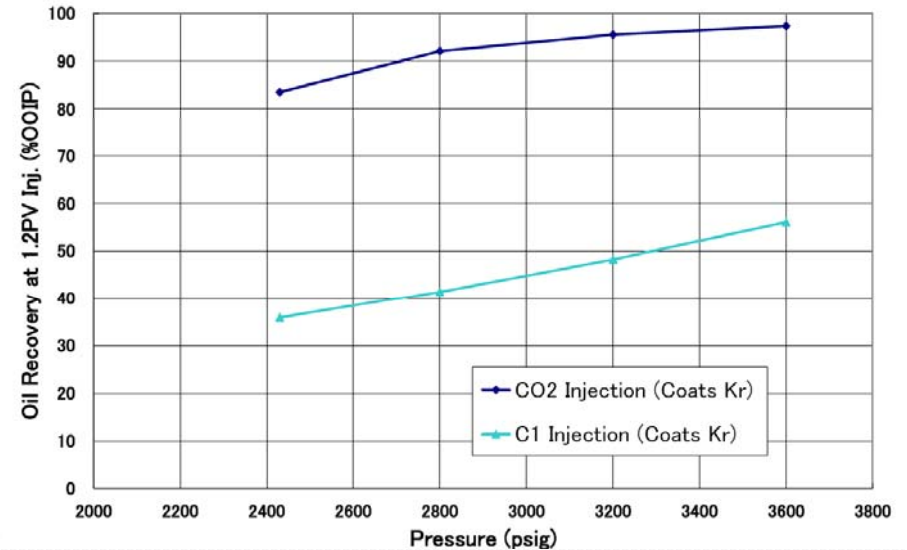
Gas processing

- Primary and Secondary Membrane
- CO₂ removal result:
 - Feed stock: ~ 44.5% CO₂
 - Sale gas: ~ 8% CO₂

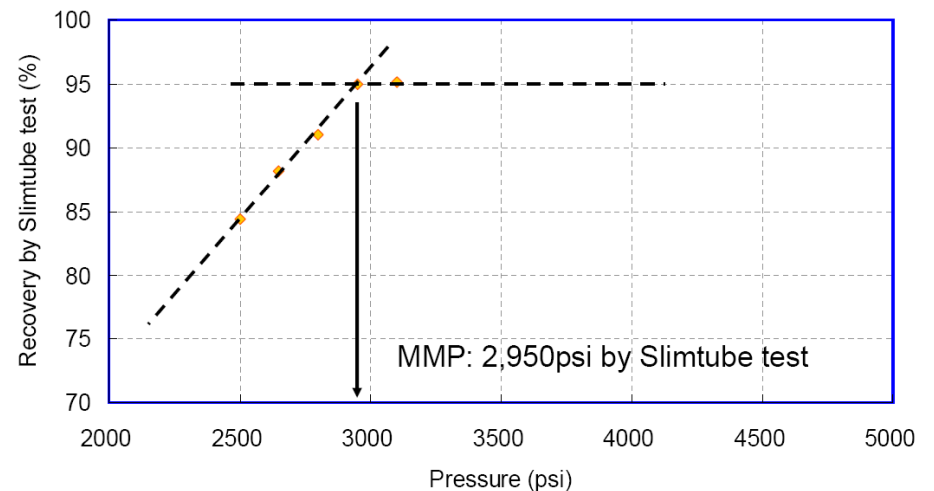


A solution for dismissed CO2 Application for EOR

- PetroVietnam, JOGMEC and NOEX have carried out a study on CO2 enhanced oil recovery for an offshore oil field
- Lab experiments showed favorable reservoir conditions for application...



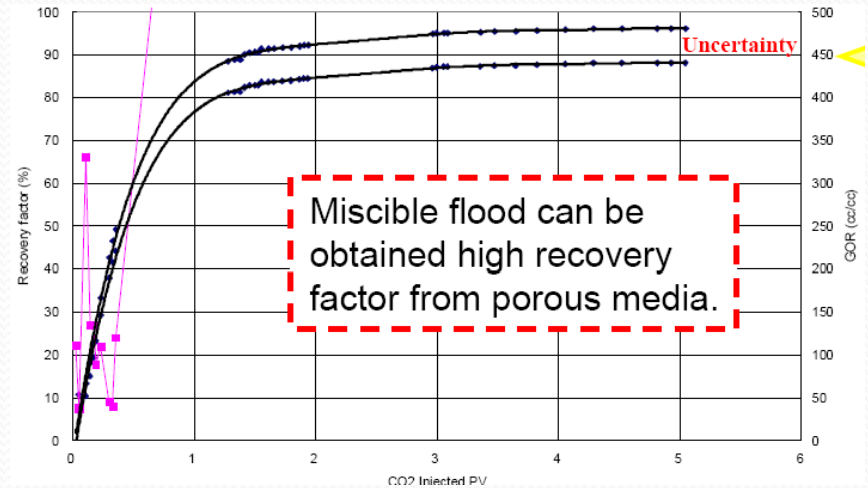
MMP by Slimtube test



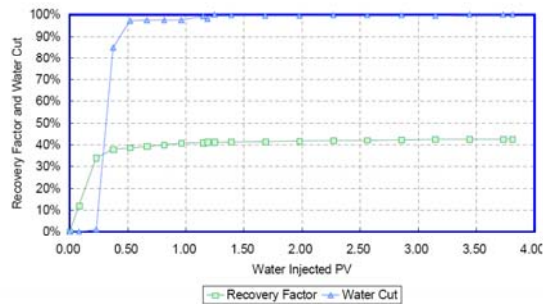


Application for EOR

- ... and positive results



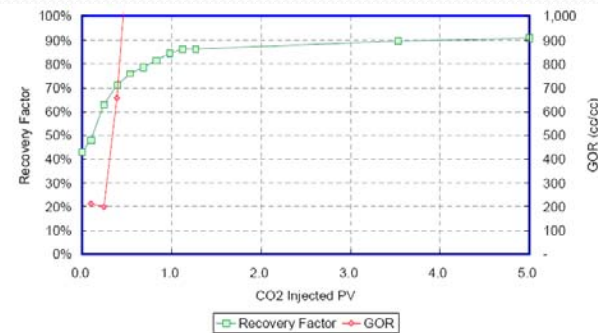
Water Injection



Recovery factor	42.5 %	68.6	40.0
Residual oil saturation	40.0 %	31.4	60.0

42.5% difference between 68.6 and 40.0

CO2 displacement



Recovery factor	88.6 %
Residual oil saturation	7.8 %

68.6	40.0	7.8
31.4	60.0	40.2
		52.0

42.5% difference between 68.6 and 40.0

88.6% difference between 40.0 and 7.8

CO2 displaced mainly to the oil.



Application for EOR

- Simulation showed that additional recovery by CO₂ EOR is about 8%
- However, CO₂ capture and transportation is expensive and makes economics rather poor at the current conditions
- Further optimization of CO₂/Hydrocarbon gas injection is being performed before a pilot test



Concluding points

- Vietnam's gas demand is extremely high. At the moment, produced gas transported only to Southern area
- Supply of the gas may not meet the demand, and development of high CO₂ gas fields is a viable solution
- PetroVietnam warmly welcomes all parties interested in technical/business cooperation on this issue



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Thank you for your
attention