TEAM M028

Design of a CCUS-EOR Model for the Oil and Gas Industry: Capturing CO_2 from Hydrogen Production and Utilizing It for Enhanced Oil Recovery

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PETE

GEO 3 CHE

Introduction

Problem Statement: **Ongoing CO_2 emissions** from hydrogen production and CO_2-EOR practices that prioritize oil recovery over CO_2 retention weaken carbon management and slow progress toward national decarbonization goals.

Objectives:

- Develop an **integrated CCUS–EOR framework** linking capture, injection, and storage.
- Enable **multi-objective optimization** of oil recovery, hydrogen production, and CO_2 storage.
- Ensure **verifiable CO_2 retention**.
- Support decisions that **balance revenue and decarbonization**.

Constraints

- Injection pressure **≤ 90%** of fracture pressure
- Reservoir thickness **≥ 20 m**
- CO_2 water content **≤ 50 ppmv**

Specifications

- Permeability **≥ 2 mD**
- Porosity **≥ 5%**
- Injection depth **≥ 800 m**
- Reservoir pressure increase **≤ 10%**
- CO_2 purity **≥ 80%** (dry basis)
- Hydrogen purity **≥ 90%**
- CO_2 storage efficiency **≥ 70%**
- Oil recovery increase **≥ 4%**
- Salinity **≤ 200,000 ppm**

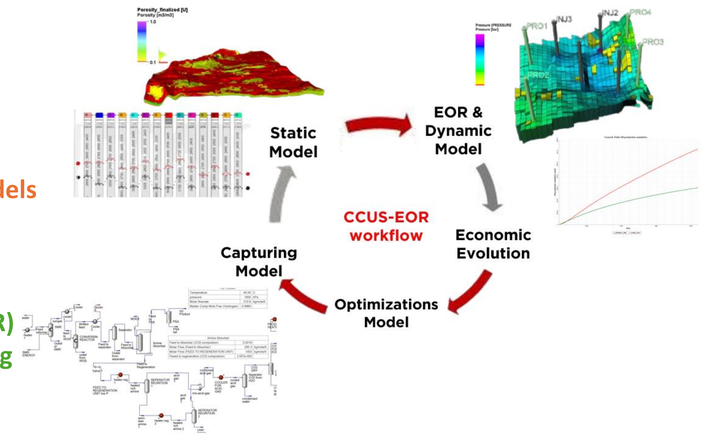
Prototype Development

GEOL :

- Seismic Interpretation
- Petrophysical Evaluation
- Reservoir 3D Property models

CHE :

- Hydrogen Production (SMR)
- CO_2 Capture & Conditioning



PETE :

- Injection & Well Design
- WAG Design & EOR performance
- Pressure & Performance Control

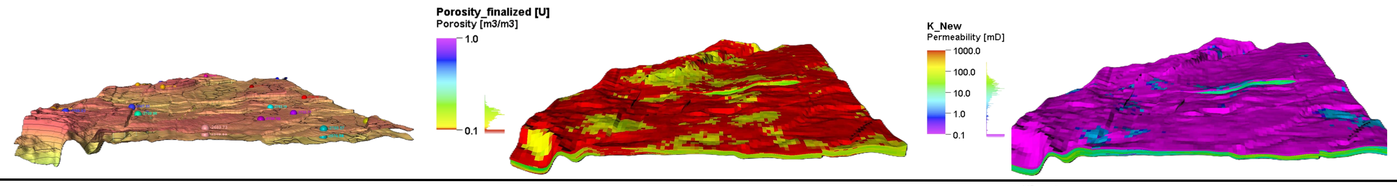
Testing and Validation

GEOL

Mean:	193.71

Mean:	0.1384

Mean:	15.4117

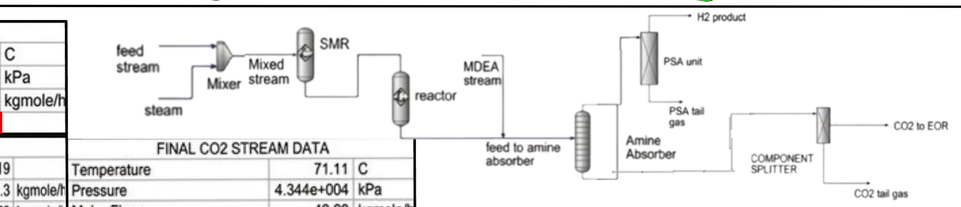


CHE

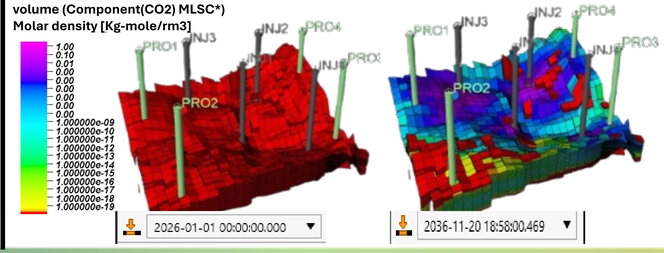
PSA UNIT - H2 PRODUCT DATA		
H2 Product:	40.00	C
H2 Product: pressure	1850	kPa
Molar flowrate	210.6	kgmole/h
Master Comp Mole Frac (Hydrogen)	0.9969	

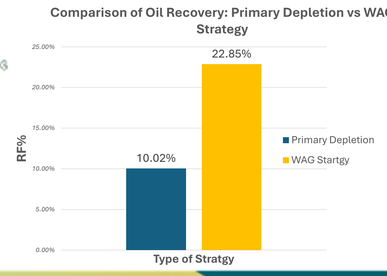
Amine Absorber		
Feed to Absorber (CO2 composition)	0.2019	
Molar Flow (Feed to Absorber)	295.3	kgmole/h
Molar Flow (FEED TO REGENERATION UNIT)	1453	kgmole/h
Feedd to regeneration (CO2 composition)	3.557e-002	

FINAL CO2 STREAM DATA		
Temperature	71.11	C
Pressure	4.344e+004	kPa
Molar Flow	48.28	kgmole/h
Master Comp Mole Frac (CO2)	1.0000	



PETE





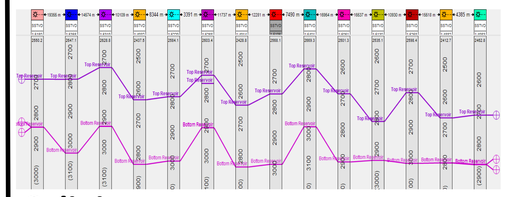
Axis	Min	Max	Delta
X	248790.24	255190.24	6400.00
Y	578538.61	584138.61	5600.00
Z	-3180.06	-2622.68	557.38
Pressure	263.8003	298.0512	34.2509

Stratgy	RF%	Difference
Primary Depletion	10.02%	12.84%
WAG Startgy	22.85%	

Integrated Specification Test

Injection depth

Depth **> 2500 m**



Salinity:

Formation water Resistivity (Rw): 0.055 ohm.m at 25 C

Formation Salinity in Range: 140,000 - 170,000 ppm

CO_2 storage efficiency

y(CO2)	TOT gas (Productiom)	CO2 (injection)
0.000130067	3,673,057,792.00	62,630,380.00
CO2 Retention%	99.237%	

Conclusion

The CCUS–EOR prototype **met all constraints and specifications**, demonstrating an integrated workflow linking blue hydrogen CO_2 capture, injection design, EOR performance, and post-depletion storage. Geological modeling confirmed adequate reservoir thickness, porosity, permeability, depth, and salinity for storage readiness, while simulation results indicated feasible EOR uplift under pressure limits and high net CO_2 retention.