



## CO<sub>2</sub> Pipelines

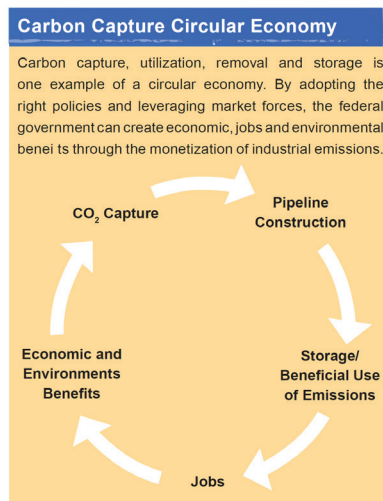
Presented by: Toan Nguyen & Balaji Ramarao

### Introduction

UPI is committed to helping companies mitigate greenhouse emissions. Carbon Capture, transportation, and storage help the low carbon footprint economy and spur transforming CO<sub>2</sub> gas into an economic resource for oil and gas operations.

Carbon dioxide (CO<sub>2</sub>) pipeline transportation and facilities are crucial infrastructure to move carbon capture to geological storage or put to beneficial use, such as enhanced oil recovery in oil and gas operations and other industrial use. Industrial and commercial investment opportunities include facilitating CO<sub>2</sub> pipeline infrastructure planning, siting, and permitting.

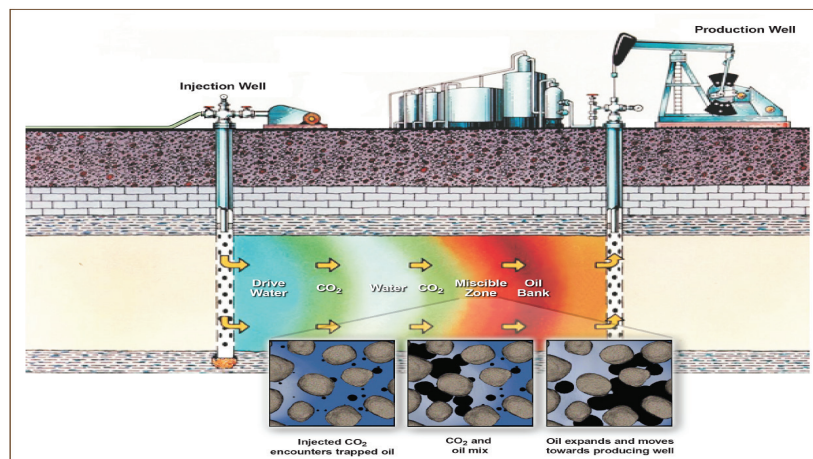
The US has about 5,000 miles of CO<sub>2</sub> pipeline networks in the Permian Basin, Gulf Coast, Rocky Mountains, and Mid-continent, and is poised to expand the pipeline infrastructure and facilities. The below chart provides overall perspective of Carbon Capture Circular Economy.<sup>1</sup>



### Enhanced Oil Recovery

Enhanced oil recovery using CO<sub>2</sub> miscible floods started in Texas in 1970.<sup>11</sup> Over 56 oil fields are currently using CO<sub>2</sub> enhanced recovery and collectively produce over 200,000 barrels per day of crude oil.

Water and CO<sub>2</sub> are injected alternately into the injection wells. The injected CO<sub>2</sub> enters the reservoir and moves through the rock's pore space. Droplets of crude oil become miscible and form a concentrated oil bank and flow towards the producing wells. The produced fluids flow through the separator to separate oil, water, and gas. The produced gas is treated to recover CO<sub>2</sub>, and the wet CO<sub>2</sub> is dehydrated, compressed, and recycled back for injection. Additional CO<sub>2</sub> is also injected for makeup to compensate for the recycle recovery. A supply/distribution pipeline delivers makeup CO<sub>2</sub>. The facilities include a meter station and booster pump to bring the CO<sub>2</sub> to the required pressure.



Cross-section illustrating how carbon dioxide and water can be used to flush residual oil from a subsurface rock formation between wells

## Carbon Capture

About 13 commercial carbon capture plants in the US capture approximately 25 million tons of CO<sub>2</sub>.<sup>III</sup> Post-combustion flue gas is absorbed with solvent, and the recovered CO<sub>2</sub> rich solvent goes through a regenerator to recover CO<sub>2</sub>. The CO<sub>2</sub> gas is treated, dehydrated, and compressed for transport in a pipeline.<sup>IV</sup>

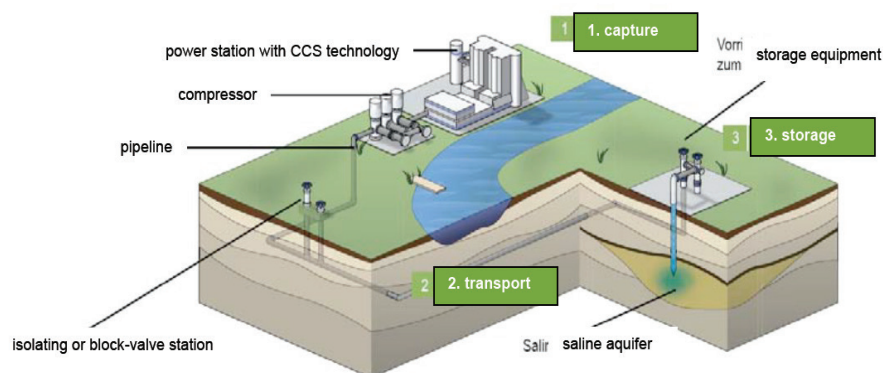


Figure 3-1 : CCS process chain: 1. capture, 2. transport and 3. storage [IZ Klima e. V., 2009]

## CO<sub>2</sub> Pipelines

CO<sub>2</sub> pipelines operate in different regions of the vapor-liquid equilibrium (VLE) phase envelope. Some pipelines operate in the dense phase region (above 1250 psig) and use booster pump stations to transport CO<sub>2</sub> in long distance and interstate pipelines. Other pipelines operate in the gas phase (low pressure) and use compressors to transport the gas.

Design considerations include the following:

- Hydraulic analysis and evaluation of elevation changes
- Pipeline pressure profile and pressure protection
- Sulfide stress cracking requirements
- Fracture control studies to define material toughness requirements
- Depressurization requirement
- Double block and bleed arrangement

## UPI Capabilities

UPI offers a full complement of solutions including: Conceptual selection, FEED, Project development, including Total Installed Costs for funding, and EPC/EPCM. The EPC/EPCM solutions include Project Management, Engineering and Design Services, Procurement Services, Sub Contractors Management, Survey, Laser Scanning, Construction Management, Inspection, Mobile Inspection Platform, Systems Integration, Automation, and Controls.

UPI has a rich heritage of pipeline and facilities project experience for pipeline planning design and construction management. UPI has engineered over 35,000 miles of pipeline and installed over 5 million Hp of pumps and compressors.

UPI's recent CO<sub>2</sub> pipeline projects include over 800 miles of pipeline and facilities including:

- 500-mile CO<sub>2</sub> pipeline upgrades to increase flow from 1.3 to 1.9 billion standard cubic feet per day (BSCFD). The scope included 70 miles of pipeline, five (5) greenfield pump stations, four (4) brownfield pump stations, and 4 miles of gathering lines.
- 220-mile CO<sub>2</sub> pipeline with three (3) pump stations.

## Closing

UPI looks forward to talking with you about how we can help you with your project.

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- I. Federal policy Blueprint May 2019. The Great Plains Institute and Center for Climate & Energy Solutions and coordinated the development of the policy by Coalition participants.
  - II. National Energy Technology Report Carbon dioxide Enhanced Oil Recovery – Untapped Domestic Energy Supply and Long Term Carbon Solution, March 2010.
  - III. Carbon Capture Coalition memo to Climate Team dated 01/21/2021
  - IV. The Costs of CO<sub>2</sub> Transport. Post-Demonstration CCS in the EU. European Technology platform for Zero Emission Fossil Fuel Power Plants, 13