2024 TIEEP SPRING ENERGY FORUM

CCUS HEADWINDS & TAILWINDS: *WHAT WILL IT TAKE?*

WEDNESDAY MAY 1, 2024 | 4:00 - 6:00 PM | ROCKWELL PAVILION, UNIVERSITY OF HOUSTON

UH Energy
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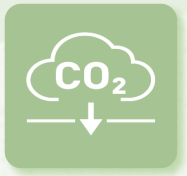
TEXAS INDUSTRIAL ENERGY EFFICIENCY PROGRAM

CCUS Infrastructure – Preparing for the Future of Houston

University of Houston – CCME

Pipeline



Storage

Electricity

Water

Acknowledgements

Center for Carbon Management in Energy
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Storage

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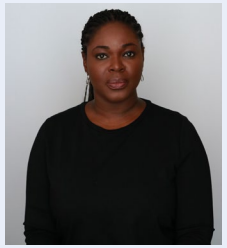

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Water

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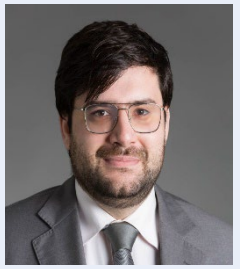

Hammad Yousaf (UH)

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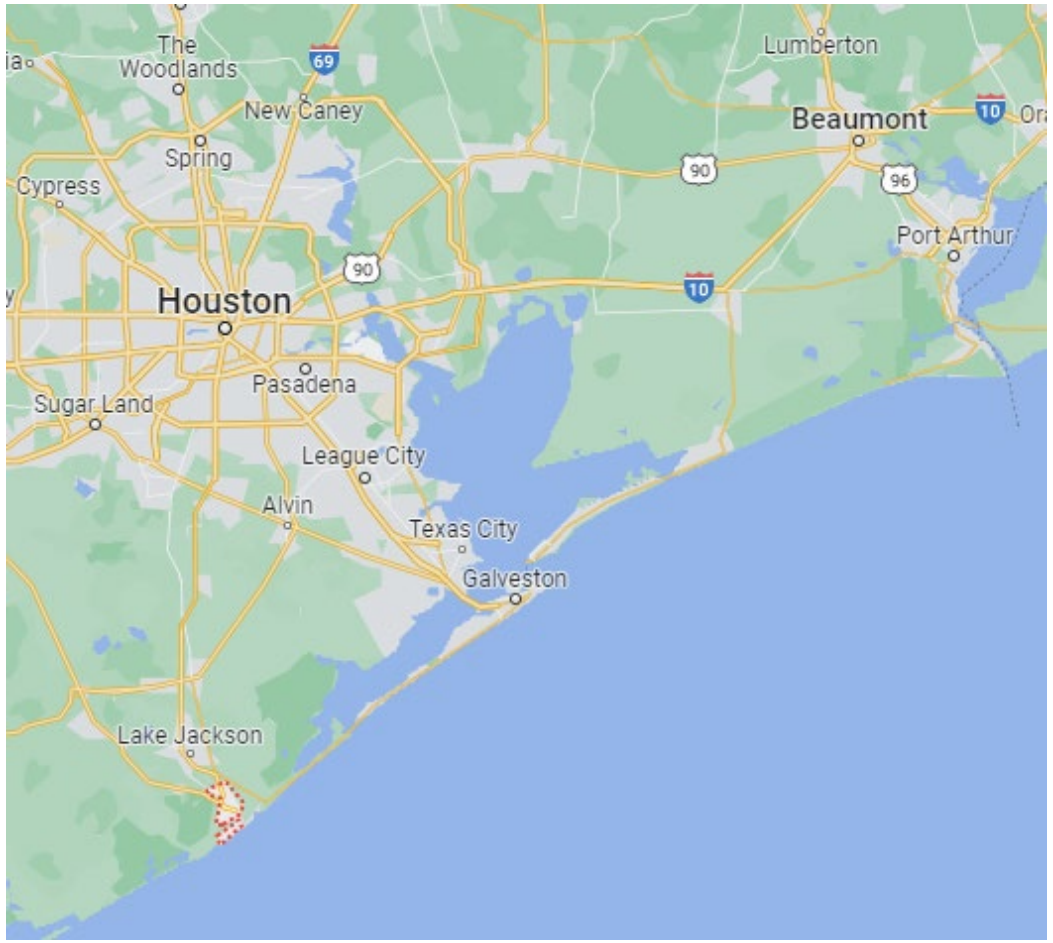
Project Scope Summary



Greater Houston: Beaumont to Freeport

- Greater Houston region from Beaumont to Freeport covering 8 counties on the Gulf Coast
- 4 Workstreams: **Pipeline, Storage, Electricity and Water**
- 3 Phases:
  - 2023 – 2030
  - 2030 – 2040
  - 2040 – 2050
- 3 Scenarios:
  - Reference case (10-20% CO_2 capture)
  - Accelerated (40-50% CO_2 capture)
  - Net Zero (90-100% CO_2 capture)
- Workforce and supply chain assessment across workstreams, phases and scenarios

Current State Foundational Facts

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Total emissions from industrial source emitters (>1 MMTPA) in the region is 90 - 110 MMTPA

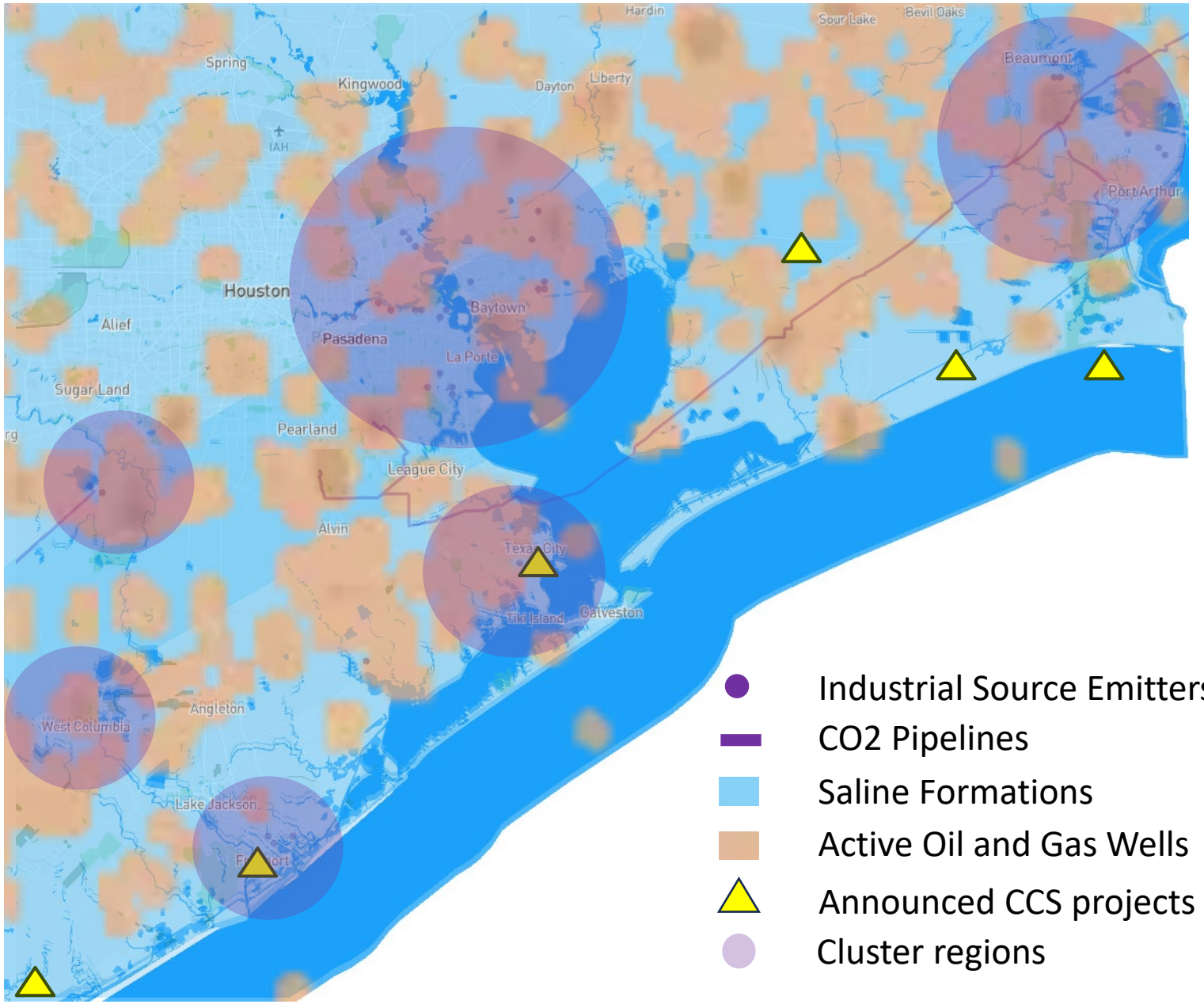
Existing facilities meet supply/treatment needs

Study region has historically been a net importer of power

Current CO_2 Pipeline infrastructure is the Denbury Green Line carrying ~16 MMPTA (20-30% of capacity) for EOR purpose

5 onshore and 1 offshore CCUS projects announced with target injection dates before 2030

Overview – Current State



CLUSTERS

↓

HUBS

↓

GEOLOGIC STORAGE

↓

ELECTRICITY SUPPLY & TRANSMISSION

↓

WATER NEEDS

No CO2 captured and stored currently

Scenario Framework (2030 – 2040 – 2050)

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Reference Case	10-20% of carbon emissions captured from industrial source emitters
Accelerated	40-50% of carbon emissions captured from industrial source emitters
Net Zero	90-100% of carbon emissions captured from industrial source emitters

Houston CCS Alliance Target

Scenario – Reference Case (10-20% CO2 Capture)

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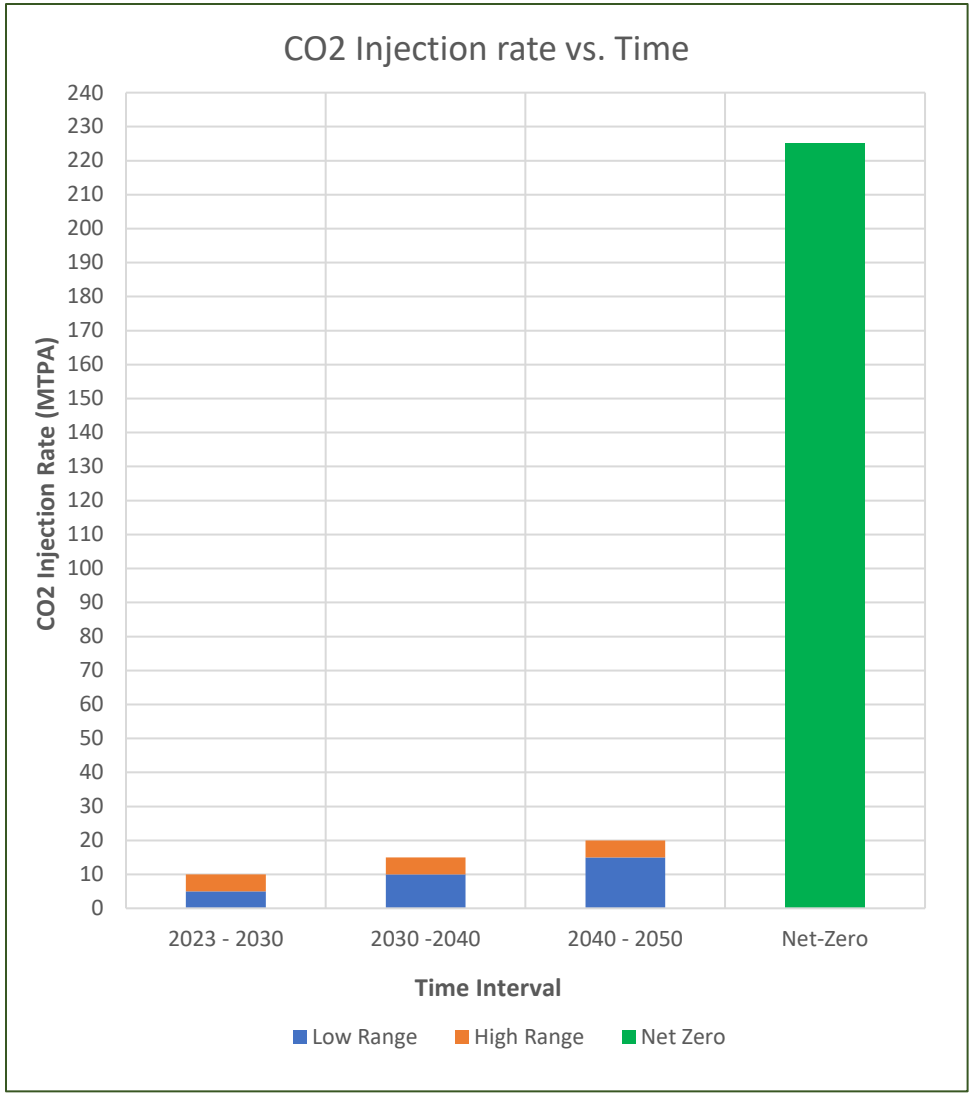


Pipeline

- Leverage existing Green Line + lateral pipeline connections from capture to storage onshore from 2030.
- Start offshore infrastructure in 2040.

Storage

- Announced 5 storage sites come online around 2030.
- Development of offshore storage required for 2040.

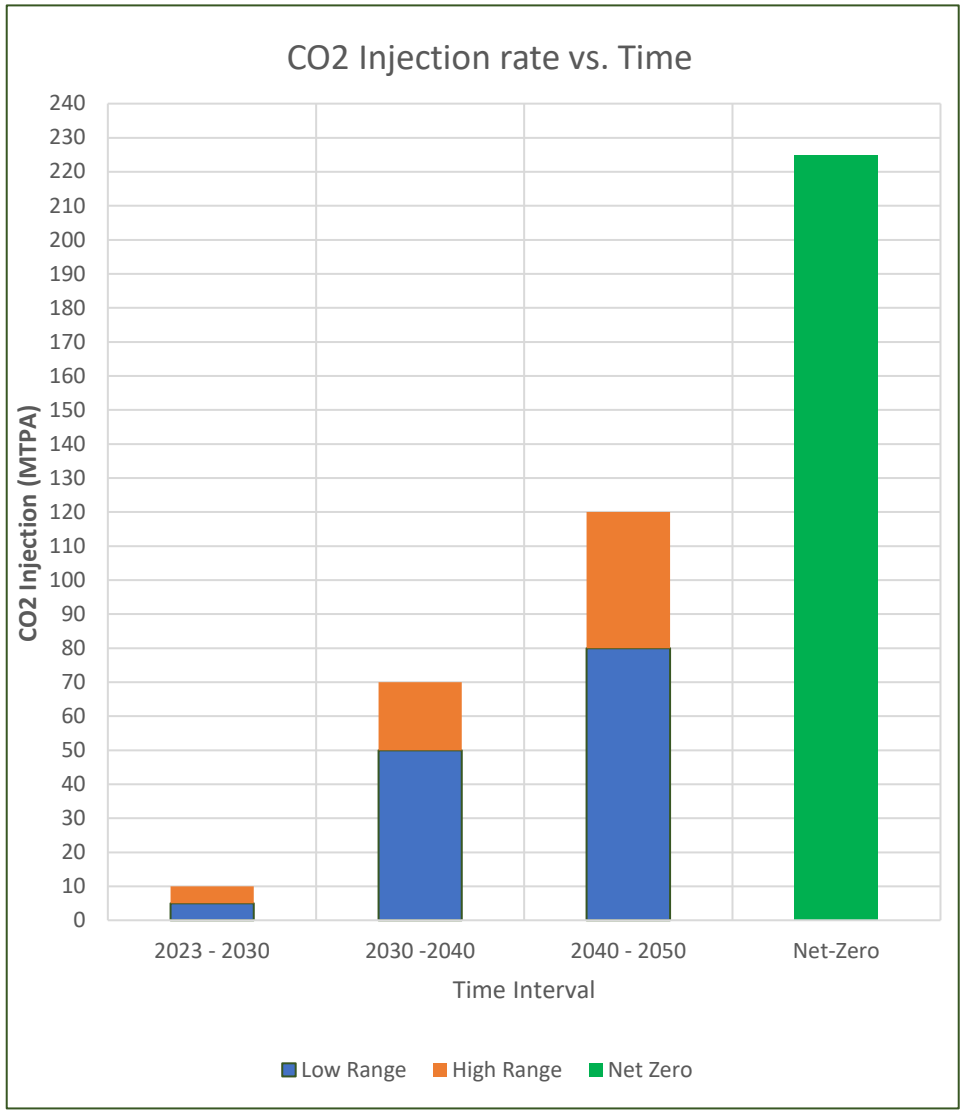
Electricity

- Existing transmission must be enhanced.
- Exisiting natural gas generation utilization can be enhanced.
- 2040 requirements must be assessed in current time frame.

Water

- Existing facilities meet the requirements.
- New surface reservoirs come online in 2040 timeframe.

Scenario – Accelerated Case (40-50% CO2 Capture)



Pipeline

- Leverage existing Green Line and develop onshore infrastructure build out from 2028.
- Offshore development required for Mid 2030s utilization.

Storage

- Announced storage sites come online 2028.
- Multiple storage sites for large scale storage both on and offshore for maximum flexibility

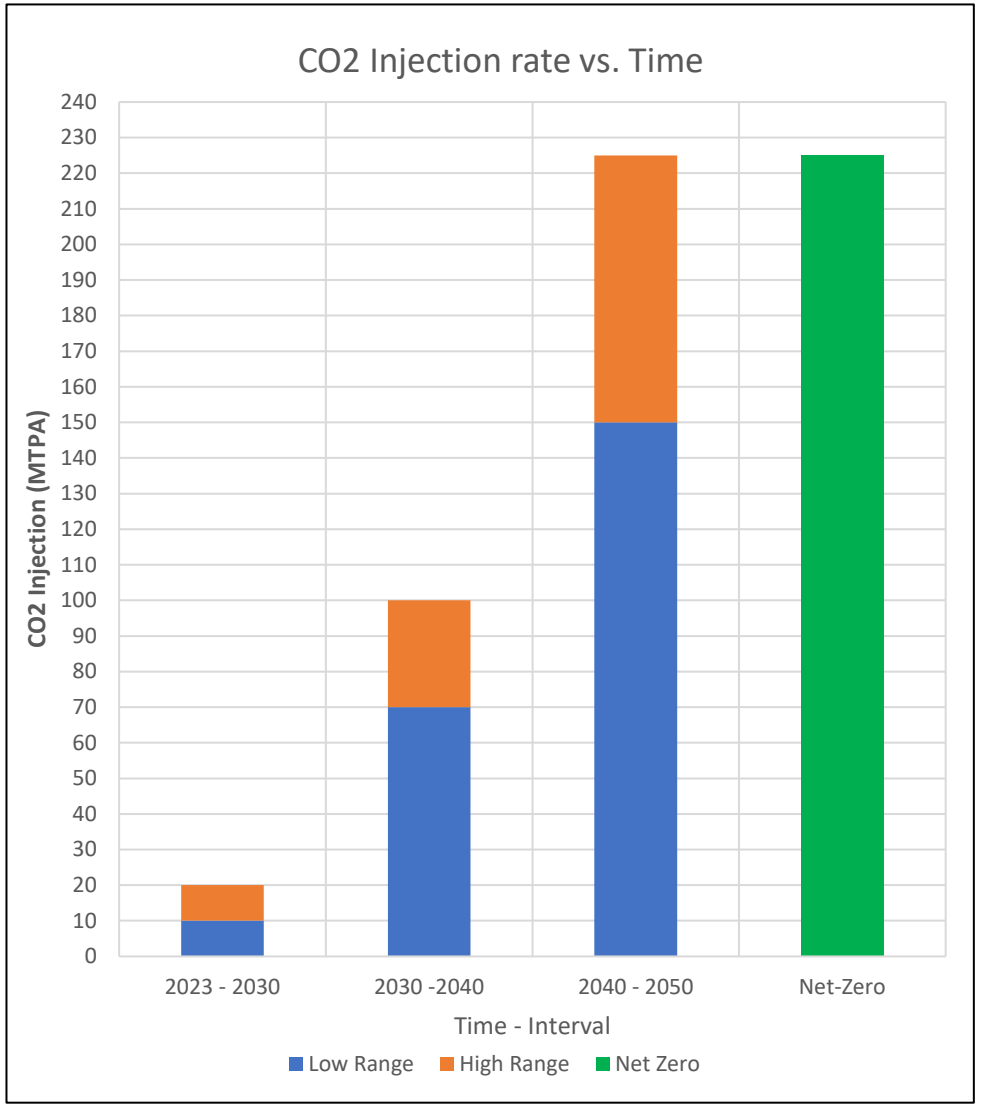
Electricity

- Enhance utilization factors of current natural gas power plants must be augmented by mid 2030s with additional capacity.
- Cogeneration facitilies may be required by the 2040 timeframe.

Water

- New surface reservoirs must come online by mid 2030s.
- Desalination plant considerations for the 2040. time horizon

Scenario – Net Zero Case (90-100% CO2 Capture)



Pipeline

- Leverage existing Green Line + extensive onshore infrastructure development from 2026.
- Clusters must develop rapidly into a Gulf coast hub.

Storage

- Multiple storage sites required for both on and offshore activity from early 2030s.
- Permitting and regulatory maturity for both on and offshore maximum utilization.

Electricity

- Enhance utilization factors of current natural gas power plants , transmission project development essential & significant strategic planning for 2040 timeframe
- Cogeneration facitilies likely required by 2040 timeframe.

Water

- New surface reservoirs come online from 2030s.
- Desalination plants will be required for the future.

Keys to Success

Pipeline

- Clusters → Hubs
- ROW and Regulatory Framework

Storage

- Actual Onshore 10-20% of Theoretical
- Offshore characterization must begin now

Electricity

- Renewable integration plus NG utilization
- Transmission and Storage must advance
- Market Construct for 24/7 carbon free supply

Water

- Supply balance will evolve
- Desalinization considered for future

Supply Chain & Workforce Challenges

Supply Chain

- Reference case does not pose any risks to supply chain material requirements.
- In Accelerated and Net Zero scenarios, potential risk for Long Lead Items (Compressors, Pumps) and Steel Pipes due to competition from multiple CCUS projects, LNG industry and upcoming Blue Hydrogen / Ammonia plants.
- Recommendations
  - **Identify suppliers and assess delivery capacity at early stage**
  - **Develop alternate suppliers as back up**

Workforce

- Current available workforce should be sufficient in reference case scenario.
- Accelerated and Net Zero cases – significant increase in manpower (~50 to 100%) will be required - especially high skilled and medium skilled workers.
- Recommendations
  - **Upskilling and Reskilling of workers**
  - **Engagement between educational institutions & employers**

Final Note

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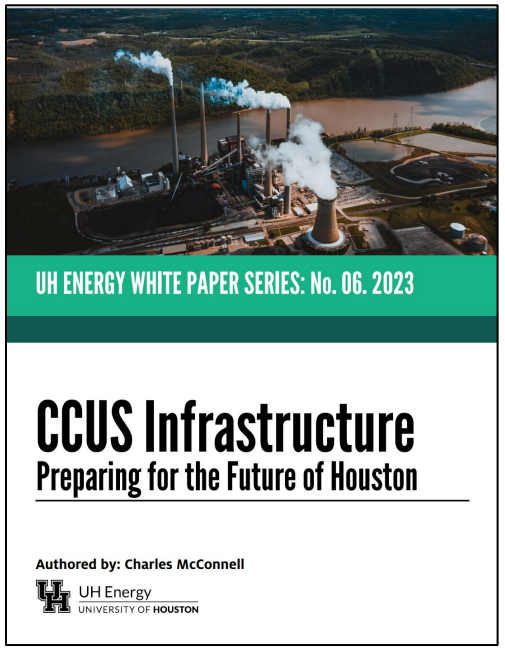
White Paper Published:

https://uh.edu/uh-energy-innovation/uh-energy/energy-research/white-papers/white-paper-files/future-of-houston-113023draftc.pdf



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