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Critical Challenges. Practical Solutions.

Energy & Environmental Research Center (EERC)

# CHARACTERIZE EXPECTED $CO_2$ SPECIFICATION RANGES FOR VARIOUS PRODUCT STREAMS

Contract # 693JK32450003CAAP

October 23, 2024

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# AGENDA

- Introductions
- PHMSA discussion
- Project Overview
- Objectives and Anticipated Results
- Scope of Work
  - Task 1.0
  - Task 2.0
  - Task 3.0
  - Task 4.0
  - Task 5.0
- Milestones and Deliverables
- Questions

# PROJECT OVERVIEW

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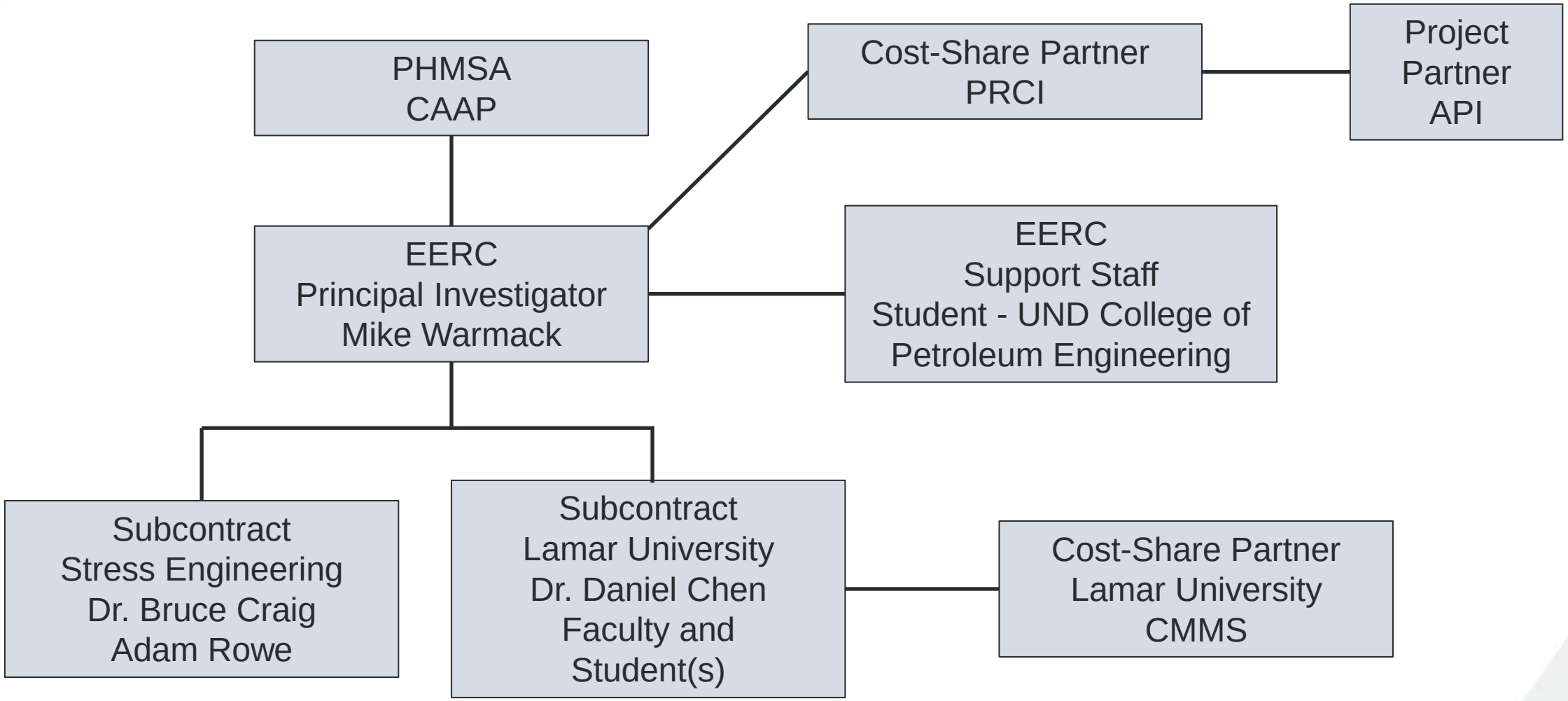
- **Period of Performance**: 09/30/2024 - 09/29/2025 (12 months)

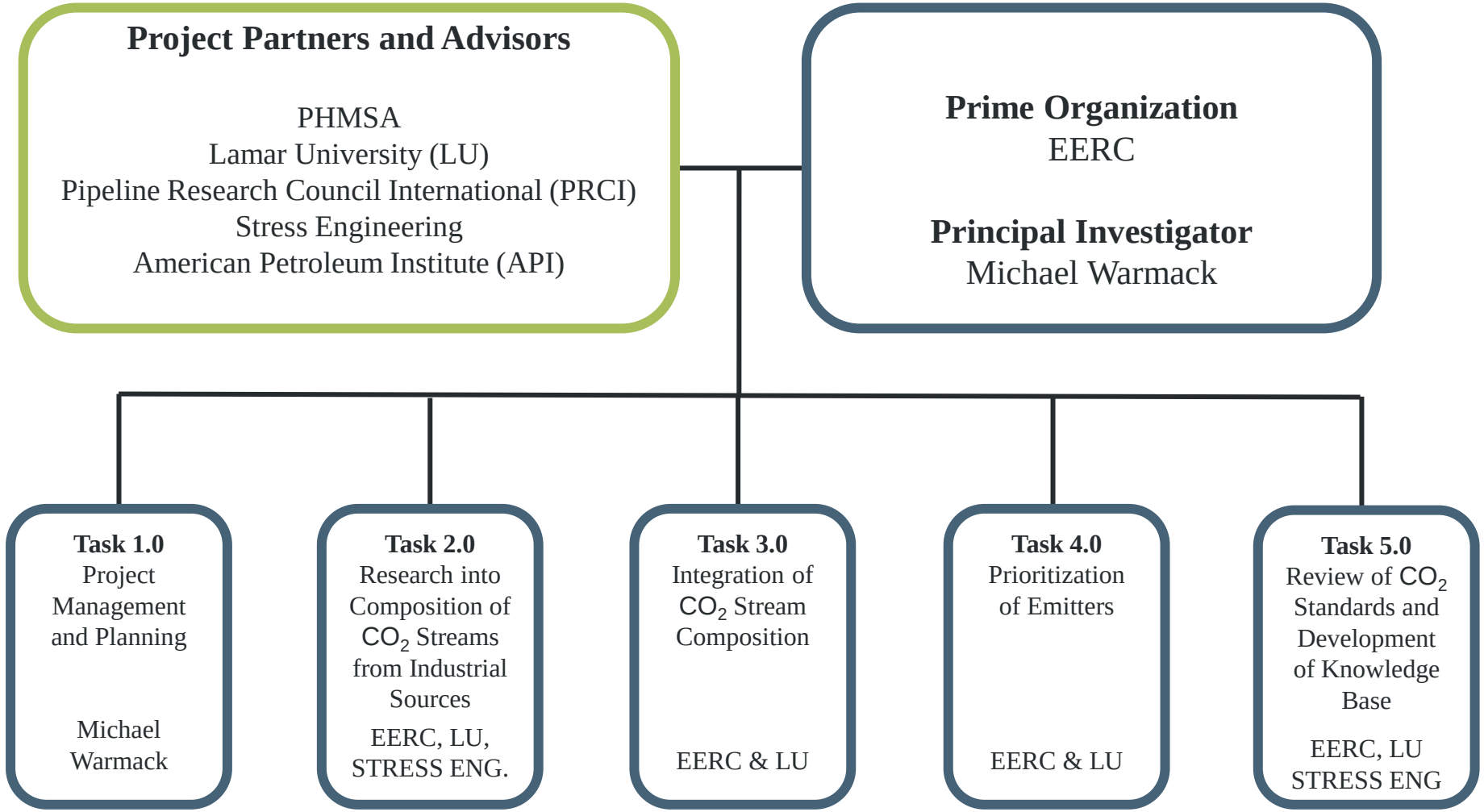
- **Major Partners:**
  - Lamar University
  - Pipeline Research Council International (PRCI)

| Budget Period | Budget Period Start | Budget Period End | DOE Share (80%) | Recipient Share (20%) | Total Estimated Costs |
|---|---|---|---|---|---|
| 1 | 09/30/2024 | 09/29/2025 | $426,500 | $106,625 | $533,125 |

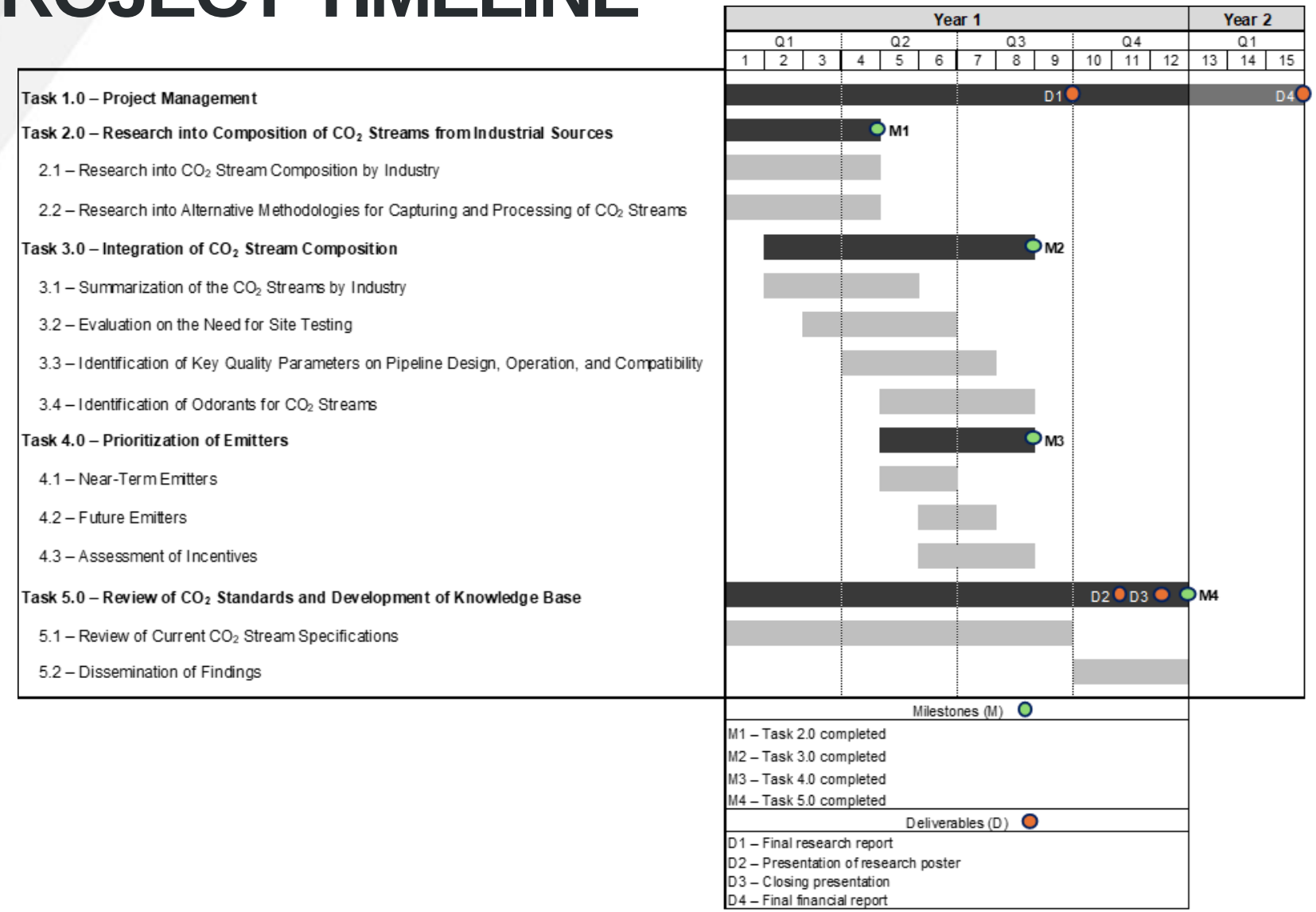
# PROJECT OVERVIEW – PROJECT PARTNERS



# PROJECT OVERVIEW – TASKS



# PROJECT TIMELINE




Timing of the Tasks may be continued throughout the project if additional information becomes available during execution of the project.

# OBJECTIVES AND ANTICIPATED RESULTS

**Objectives:** To comprehensive characterize the expected compositional ranges and product quality specifications with upper and lower bound ranges for $CO_2$ product streams derived from diverse sources, including ethanol production, cement manufacturing, power generation facilities, steel manufacturing, and direct air capture (DAC), with an emphasis on near-term emitters.

**Anticipated Results:**

- Provide a knowledge base that characterizes $CO_2$ streams form various sources related to carbon capture, utilization and storage (CCUS).
- Inform pipeline standards.
- Identify any additional characterization knowledge gaps.
- Provide insight on recommended practices.

# SCOPE OF WORK

# TASK 1.0 – PROJECT MANAGEMENT, PLANNING AND REPORTING

- Major Activities:
  - Ensure project completion within term of project (1 year)
  - Compliance with grant requirements
  - Manage project risks
  - Project reporting and documentation
  - Regular communications with
    - PHMSA project manager
    - Project partners
    - Industry partners

# TASK 2.0 – RESEARCH INTO COMPOSITION OF $CO_2$ STREAMS FROM INDUSTRIAL SOURCES

- Major Activities:
  - Detailed review of public, private, industrial, governmental, or other information as available.
  - Analysis of different methodologies used to capture and prepare the $CO_2$ for transportation on active or officially announced projects.
    - ♦ Documentation of comparison between methodologies.
  - Review public data for availability on the actual composition of $CO_2$ streams from industrial sources.

# SUBTASK 2.1 – RESEARCH INTO $CO_2$ STREAMS BY INDUSTRY

- Work to be performed by graduate students:
  - Collection, aggregation and documentation of $CO_2$ streams by industry from public information, and consultants or industrial partners.
  - Document emission volumes for listed plants based on U.S. Environmental Protection Agency (EPA) Greenhouse Gas (GH) Emissions data or other sites.
- Institutions leading research:
  - EERC – power generation, ethanol production, cement manufacturing, and DAC
  - LU – steel manufacturing, natural gas processing, hydrogen and syngas plants, and olefin plants.
- Check of impurity limits through thermodynamic software and other applications.
- Assessment on compatibility of $CO_2$ streams with carbon steel (CS) pipeline material.

# SUBTASK 2.2 – RESEARCH INTO ALTERNATIVE METHODOLOGIES

- Major Activities:
  - Review of methodologies in use for the capture and processing of $CO_2$ streams.
  - Evaluate emerging low-cost capture technologies.
  - Review the impact of post combustion treatment methods.
  - Provide a comparison of the resulting $CO_2$ streams.

# TASK 3.0 – INTEGRATION OF $CO_2$ STREAM COMPOSITION

- Major Activities:
  - Summarization of information on $CO_2$ streams from various industrial sources by:
    - Document the maximum and minimum levels of each component within the industrial $CO_2$ streams.
    - Evaluate the need for site testing to bolster the available industrial information.
    - Identification of key quality parameters impacting pipeline design, operation and compatibility.

# SUBTASK 3.1 – SUMMARIZATION OF $CO_2$ STREAMS BY INDUSTRY

- Major Activities:
  - Development of a detailed listing of $CO_2$ streams by industrial source.
  - Identification of:
    - ♦ Typical and variable components
    - ♦ Major and minor components
    - ♦ Potential contaminants and trace elements

# SUBTASK 3.2 – EVALUATION OF THE NEED FOR SITE TESTING

- Major Activities:
  - Determination what, if any, data gaps exist.
  - Determine if site-specific testing should occur.
    - ♦ Site testing is outside the scope of this project.

# SUBTASK 3.3 – IDENTIFICATION OF KEY QUALITY PARAMETERS

- Major Activities:
  - Perform an assessment on how the industrial $CO_2$ stream can affect the design, operation and compatibility of a pipeline system.
  - Identify the effects that dehydration and other components have on the properties of the $CO_2$ stream.
  - Examine the affect of extreme impurity concentrations has on the change in physical properties such as the formation of free water, hydrates, ice (water and dry), and acids based on temperature, pressure and compositions conditions.

# SUBTASK 3.4 – IDENTIFICATION OF ODORANTS FOR $CO_2$ STREAMS

- Major Activities:
  - Perform research into the use of odorants for $CO_2$ streams:
    - Determine what odorants can be used.
    - How the addition of odorant could benefit and affect the transportation of the $CO_2$ stream in a pipeline.

# TASK 4.0 – PRIORITIZATION OF EMITTERS

- Major Activities:
  - Evaluation of the cost of prevailing carbon capture option by industry.
  - Identification of near-term and future emitters.
    - Near-term - Determination of plants that can utilize the existing 45Q and 45V credits.
    - Future – Review what additional incentives or options would be required to broaden the capture of $CO_2$ from future emitters.

# TASK 4.1 – NEAR-TERM EMITTERS

- Major Activities:
  - Evaluation made on plants that can utilize 45Q and 45V incentives.
  - Perform a high-level review of aggregating plants to take advantage of existing or new pipeline infrastructure.

# TASK 4.2 – FUTURE EMITTERS

- Major Activities:
  - Assess plants that are not able to economically benefit from the 45Q and 45V tax incentives.
  - Review of enhancement(s) required such that a much larger percentage of the emitters could be captured.

# TASK 4.3 – ASSESSMENT OF INCENTIVES

- Major Activities:
  - Provide a high-level review of the incentive listed in 45Q and 45V.
  - How the use of 45Q and 45V could provide a gateway for capturing $CO_2$ streams for CCUS projects.

# TASK 5.0 – REVIEW OF $CO_2$ STANDARDS AND DEVELOPMENT OF KNOWLEDGE BASE

- Major Activities:
  - Review current $CO_2$ transport industry standards.
  - Provide an assessment of whether new standard(s) should be utilized.
  - Provide a method for the dissemination of findings to other stakeholders.

# TASK 5.1 – REVIEW OF CURRENT $CO_2$ STREAM SPECIFICATIONS

- Major Activities:
  - Review of existing $CO_2$ stream specifications serving the $CO_2$ transportation industry.
    - ♦ Detail how the streams determine in Subtask 2 could impact the standards.
  - Provide a recommendation on the level of impurities within various industrial $CO_2$ streams for various compounds.
  - Provide a preliminary assessment on the impact of impurities on the dispersion of released $CO_2$ gases.

# TASK 5.2 – DISSEMINATION OF FINDINGS

- Major Activities:
  - Provide a mechanism for the dissemination of the finding from this study to include:
    - ♦ An electronic database comprising the composition of $CO_2$ streams from industrial sources.
    - ♦ Conference meetings – poster and/or presentation to PHMSA designated audience.

# MILESTONES AND DELIVERABLES

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| Milestone No. | Milestone Title | Estimated Completion Date |
|---|---|---|
| M1 | Task 2.0 completed | 1/30/25 |
| M2 | Task 3.0 completed | 5/30/25 |
| M3 | Task 4.0 completed | 5/30/25 |
| M4 | Task 5.0 completed | 9/29/25 |

| Deliverable No. | Deliverable Title | Estimated Completion Date |
|---|---|---|
| D1 | Final research report | 6/29/25 |
| D2 | Presentation of research poster | 9/29/25 |
| D3 | Closing presentation | 8/29/25 |
| D4 | Final financial report | 12/29/25 |

# QUESTIONS?

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# THANK YOU

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