Readout Report: Workgroup #1 Carbon Dioxide (CO_2) Pipelines

Workgroup Leaders

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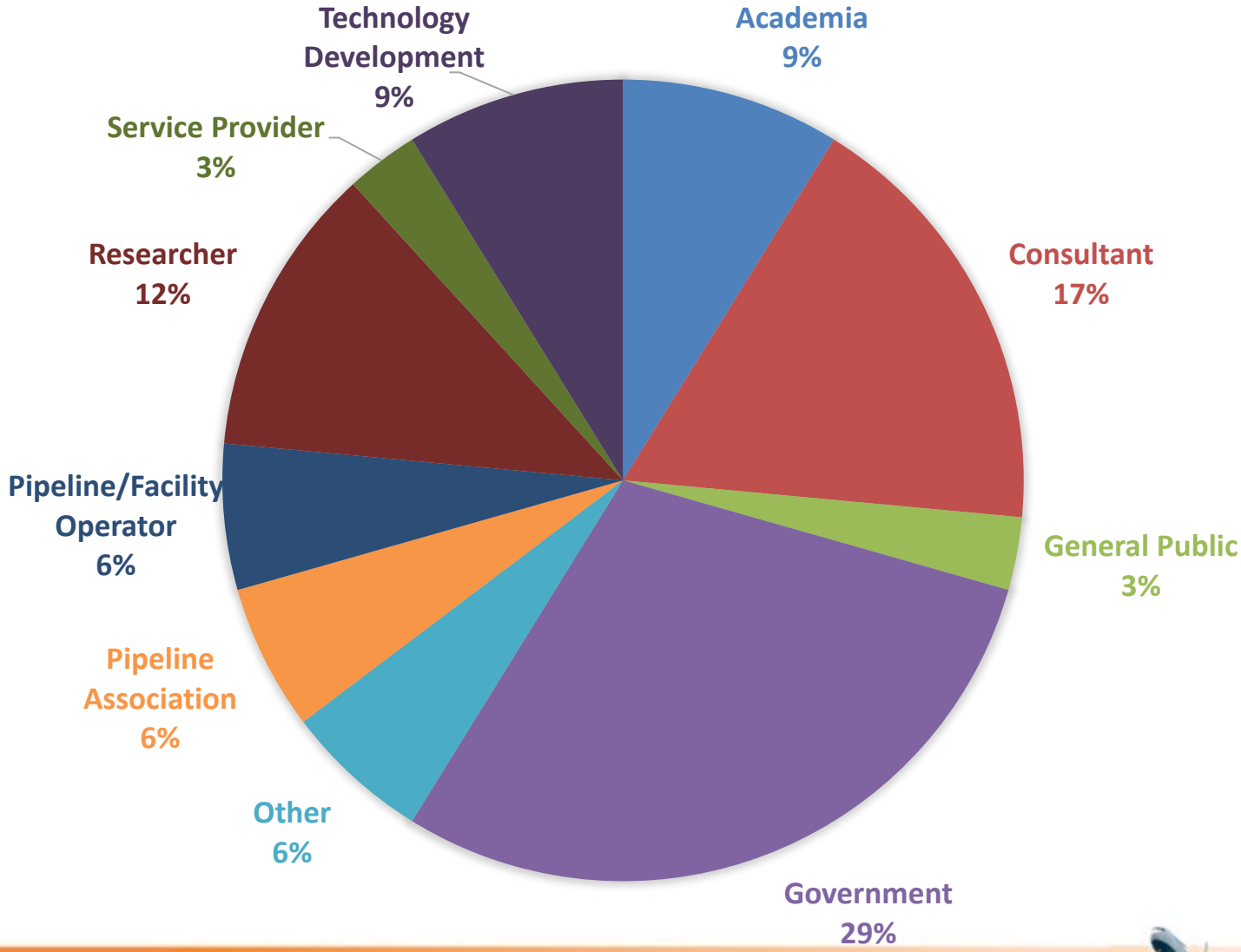
Working Group Participation by Industry



Top 4 Identified R&D Gaps

Gap #1 – EOS refinement for CO2 pipelines (Output type: General Knowledge)(Infrastructure type: Pipeline/CO2)

Gap #2 – Refine fracture control models for CO2 (Output type: General Knowledge)(Infrastructure type: Pipeline/CO2)

Gap #3 – Validate and apply dispersion modeling for CO2 release (Output type: General Knowledge)(Infrastructure type: Pipeline/CO2)

Gap #4 – Non-metallic materials compatibility for CO2 service (Output type: General Knowledge)(Infrastructure type: Pipeline/CO2)

NOTE: RED text indicates gaps with a possible academic focus.

Gap #0

Title: CO2 specification
Main Objective: Characterize expected CO2 specification upper and lower bound ranges for different sources of CO2, e.g., ethanol, cement, power generation facilities, steel, etc.

Survey/workshop/discussion/literature review with various sources and capture service providers.

Potentially include odorants.

Economic analysis.

Gap #1 Associated Details

Title: EOS refinement for CO2 pipelines
Main Objective: Understand the impact of impurities/contaminants/additives (potentially odorants) on EOS and phase equilibrium and potential corrosive impacts to ensure the integrity of pipelines transporting anthropogenic CO2
Scope:

- Review literature or research results from other private or public research efforts to assist in achieving the project goals
- Characterize expected CO2 specification upper and lower bound ranges for different sources of CO2, e.g., ethanol, cement, power generation facilities, steel, etc.
- Use thermodynamic models to define water solubility and strong acid solubility over a range of CO2 specifications and pipeline operating conditions (ensure we stay within the range of transport within the phase diagram)
- Experimentally validate thermophysical equilibrium models
- Experimentally evaluate corrosion potential of trace elements
- Involve participation with standards organizations
- Deliver reported results within 36 months with a total project cost of up to $2.5-3 million

Gap #2 Associated Details

Title: Refine fracture control models for CO2 pipelines
Main Objective: Extend fracture control models for modern steels for anthropogenic CO2 service, including mid- to full-scale testing. Results can be used to inform design and operation risk management.
Scope:

- Review literature or research results from other private or public research efforts to assist in achieving the project goals
- Characterize expected CO2 specification upper and lower bound ranges for different sources of CO2, e.g., ethanol, cement, power generation facilities, steel, etc.
- Account for modern steel making effects on fracture control evaluations, e.g., BTCM
- Involve participation with standards organizations
- Review any applicability to ASME pipeline design standards, API 5L3 (or the equivalent from ASTM)
- Perform mid- to full-scale testing to validate fracture control models
- Deliver reported results within 48 months, with a total project cost of $3 million to $15 million depending on testing.

Gap #3 Associated Details

Title: Validate and apply dispersion modeling for CO2 release
Main Objective: Validate and apply dispersion modeling across a number of conditions and phases in planned and unplanned releases for risk management and emergency response.
Scope:

- Review literature or research results from other private or public research efforts to assist in achieving the project goals
- varying lengths of fracture and flow rate out of the fracture, different terrain types, anthropogenic sources, ambient conditions, different phases
- Investigate dispersion from venting operations to inform facility design
- Consider fast-running dispersion models
- Characterize levels of assessment with increasing computation complexity and input requirements
- Consider how dispersion models could be applied to provide guidance on emergency response decision making
- Define expected CO2 specification upper and lower bound ranges for different sources of CO2, e.g., ethanol, cement, power generation facilities, steel, etc.
- Deliver reported results within 36 months, with a total project cost of $1.25 million

Gap #4 Associated Details

Title: Non-metallic materials compatibility for CO2 service
Main Objective: Determine compatibility of non-metallic pipe and components with anthropogenic CO2 streams.
Scope:

- Review literature or research results from other private or public research efforts to assist in achieving the project goals
- Characterize expected CO2 specification upper and lower bound ranges for different sources of CO2, e.g., ethanol, cement, power generation facilities, steel, etc.
- Determine if performance is suitable for pipeline systems
- Involve participation with standards organizations
- Utilize input from manufacturers, facility operators, service providers, national labs, etc.
- Deliver reported results within 36 months, with a total project cost of $1 million

Thank You!/Questions?