

# Challenges and R&D Needs for CO<sub>2</sub> Transport

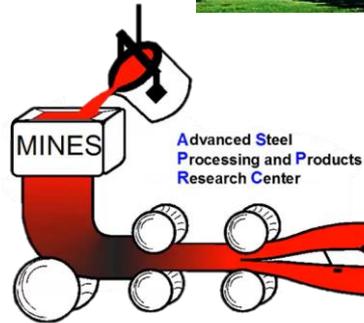
Date: Feb. 21, 2023

**Lawrence Cho and Kip Findley**

Department of Metallurgical and Materials Engineering  
Advanced Steel Processing and Products Research Center  
Colorado School of Mines

*Roadmap for CO<sub>2</sub> Transport Fundamental Research Workshop*

# Advanced Steel Processing and Products Research Center



**ASPPRC** Established 1984



# *Discussion during Sept 22 Workshop at Mines...*

---

Workshop on “**Steel Applications for CCS and CO<sub>2</sub> Transport**”  
*supported by the ASPPRC and Mines’ Office of Research and  
Technology Transfer*

*Date: Sept 22, 2022*

**Goal and Scope:** In this workshop, we seek to discuss the past and current R&D efforts and future activities needed to facilitate industrial implementation and widespread use of the CCS technology, particularly related to steel applications such as CO<sub>2</sub> pipeline.

~100 participants from oil and gas industry, steel producers and users, government agency, standard community, national labs, and academia

# Key Challenges

---

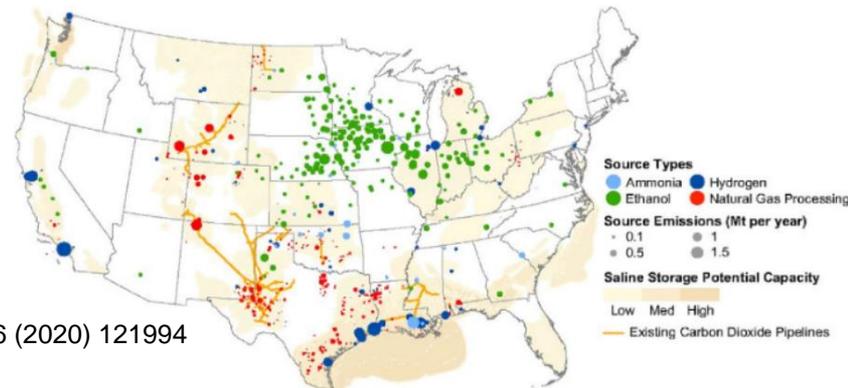
- Scaling
- Cost - Alloys/supply/dehydration
- Composition of CO<sub>2</sub> – impurities/water
- Corrosion and Fracture
- Standardization
- Testing infrastructure
- Lab results translated to application

Materials and design considerations

*...Workshop on “Steel Applications for Carbon Capture and Storage and Carbon Dioxide Transport” organized by ASPPRC, Mines on Sept 22, 2022*

# Key Challenges

- Scaling
- Cost - Alloys/supply/dehydration
- Composition of CO<sub>2</sub> – impurities/water
- Corrosion and Fracture
- Standardization
- Testing infrastructure
- Lab results translated to application
- *Intermodal transportation?*



H. Lu et al. / Journal of Cleaner Production 266 (2020) 121994

...Workshop on “Steel Applications for Carbon Capture and Storage and Carbon Dioxide Transport” organized by ASPPRC, Mines on Sept 22, 2022

...Workshop on “workshop on CO2 Freight Transport”, organized by USEA/DOE-FECM on Oct 12, 2022

# *Critical Activities*

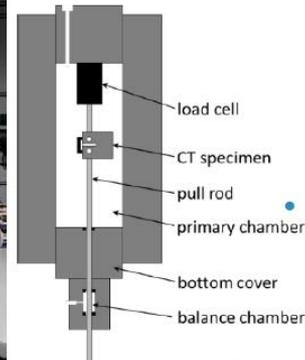
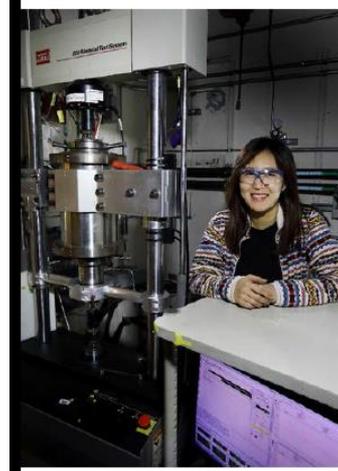
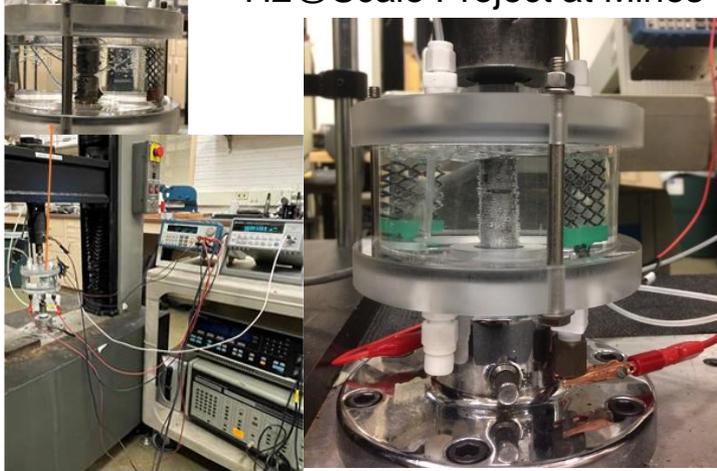
---

- **Standards Development** specific to CO<sub>2</sub> transport
  - Alternative testing
  - Conservative design in near term
- **Identify acceptable levels of impurities**
- **Integrity of existing lines** (very few capable)
- **Weld integrity**
- **Investment in testing infrastructure**
- **Economic analysis of scrubbing versus steel** (e.g. thickness, new alloys)
- Database of properties
- Public Education

*...discussed during the workshop on “Steel Applications for Carbon Capture and Storage and Carbon Dioxide Transport” organized by ASPPRC, Mines on Sept 22, 2022*

# Complementary to R&D for H Transport

H2@Scale Project at Mines



Ronevich (SNL), 2019

- **Co-design of CO<sub>2</sub> and H pipelines**
  - Fracture control and weld integrity
  - Accelerated, more accessible, and cheaper testing
  - Lab results translated to application
  - Use of higher strength pipelines (e.g. X65 and above)
  - Standards development and modification
  - Repurposing? Operational conditions?

# *Collaborations/Opportunities*

---

- New DOE FOAs/CIFIA
- DOT – CAAP/SBIR/CORE/Interagency
- Joint **pre-competitive work on impurities**
- **Multidisciplinary problem:**
  - Mechanical/metallurgy/corrosion/CFD/thermo-dynamic
- Industry/National Labs/Academia

*...discussed during the workshop on “Steel Applications for Carbon Capture and Storage and Carbon Dioxide Transport” organized by ASPPRC, Mines on Sept 22, 2022*