Emerging CCS country needs and progress - Taiwan

Chi-Wen Liao¹, Ya-Mei Yang¹, Cheng-Hsien Shen¹, Hou-Peng Wan¹, Chung Huang², Ming-Wei Yang², Shien-Kuei Liaw³

¹ Industrial Technology Research Institute, Taiwan
² Taiwan Power Company, Taiwan
³ National Taiwan University of Science and Technology, Taiwan

2020/02/12
Content

- Storage Potential in Western Taiwan
- Current Status of CCS Technology in Taiwan
- Recent Progress
- Need and Path Forward
Storage Potential in Western Taiwan

Estimates CO₂ storage capacity:
- Onshore oil and gas structures: 2,800 MT CO₂
- Coastal and offshore deep saline aquifers 68,000 MT CO₂

- Most power plants and industrial parks are located in the western part of Taiwan, where suitable sedimentary basins and rock formations for CO₂ storage are available

- Up to 8 km thick sediment
- Taiwan strait and coastal area (saline)
- Western foothills (oil/gas structure)
CO₂ Capture: Calcium looping
- 1.9MWt and 500kWt pilot trials in eastern Taiwan (Taiwan Cement Corporation, ITRI and Bureau of Energy, Taiwan)
- Preparing for scale-up and demo plant construction (10MWt, 55,000t-CO₂/yr)
- Utilizing the captured CO₂ to grow microalgae for valuable products at the end of the process

CO₂ Capture: Solar-assisted post-combustion carbon capture
- Testing solar-assisted post-combustion carbon capture for an existing coal-fired power plant in Taichung (Taiwan Power Company)
- Planning a pilot scale capture test facility and the establishment of carbon reduction technology park

Utilization
- Haematococcus pluvialis
Current Status of CCUS Technology in Taiwan

**CO₂ Storage:**
- Capacity building on site characterization, monitoring, and numerical simulation (*ITRI* and Bureau of Energy, Taiwan)

**CO₂ Storage:**
- Geological drilling, site characterization, and baseline data collection (*Taiwan Power Company*)

A 3,000 meters geological characterization well (completed)

Site Characterization

3D Geological Modeling and Capacity Estimation

Numerical simulation of CO₂ injection

Baseline data collection (ongoing)
Recent Progress – Monitoring/Risk

**Monitoring**
- High sensitivity fiber-optic CO$_2$ sensing material based on HPTS (8-Hydroxypyrene-1,3,6-trisulfonic acid trisodium salt, a fluorescent pH indicator)
- Distributed down-hole monitoring based on BOTDA (Brillouin Optical Time Domain Analysis) technology (Tsai et al., 2019)

**Risk Assessment**
- Capacity building on quantitative risk assessment with NETL - National Risk Assessment Partnership (NRAP)
- Case study on onshore and offshore storage site using NRAP IAM-CS (Liao et al., 2018)
- Use case under development using NRAP Open-IAM

CO$_2$ sensing material S/N ratio improvement by 90-fold after nano gold modification

Distributed sensing based on BOTDA technology: spatial resolution ~ 4m / 15km fiber (lab work)

Quantitative Risk Assessment: Risk profiles and CO$_2$ retained under different scenarios
Recent Progress – Public Communication

**Public outreach**
- Barriers remain to be overcome for geological storage – public acceptance
- Public Outreach Forum for Geologic Carbon Storage on Feb. 6, 2020
  - Understand the stakeholders’ attitudes towards and awareness, perceptions, interests and concerns of CCS
  - Facilitate the dialogue among the experts in public communication, the experts in CCS technologies and the local NGO groups
  - Propose a workable plan to facilitate the public communication and engagement of geologic carbon storage

**Adaptation of ISO standard**
- Efforts on adaptation of standards to increase public awareness
- Promoting and drafting national standards in collaboration with Taiwan CCSU association (adaptation of ISO27917 Vocabulary — Cross cutting terms – recommendation draft submitted to Bureau of Standards, Metrology and Inspection)
Need and Path Forward

- **Alternatives to onshore geologic CO₂ storage**
  - Transboundary CO₂ transportation if domestic storage is not available
  - Possibility for regional offshore CO₂ hub (collect / re-distribute / storage)

- **Public communication and engagement of geologic carbon storage**
  - Practical solutions for effective public outreach and engagement

- **International collaboration and knowledge exchange**
  - Capacity building of offshore site characterization and monitoring technologies
Acknowledgment and Contact Information

This research is supported by Bureau of Energy, Ministry of Economic Affairs, Taiwan, Republic of China (ROC)

Contact Information

Chi-Wen Liao
cwliao@itri.org.tw
+886-63636736