

**EPR**

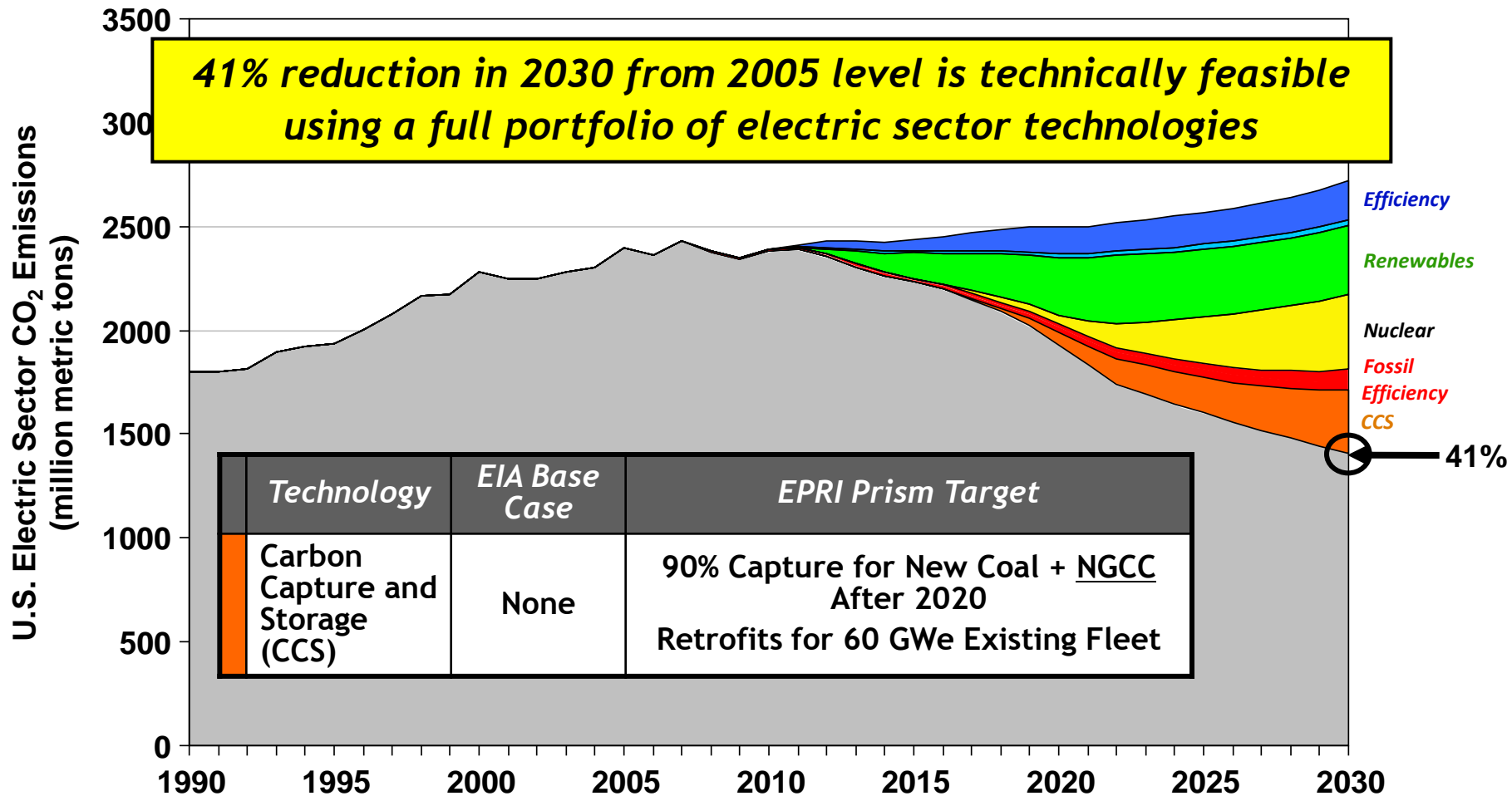
ELECTRIC POWER  
RESEARCH INSTITUTE

# CO<sub>2</sub> Capture and Storage

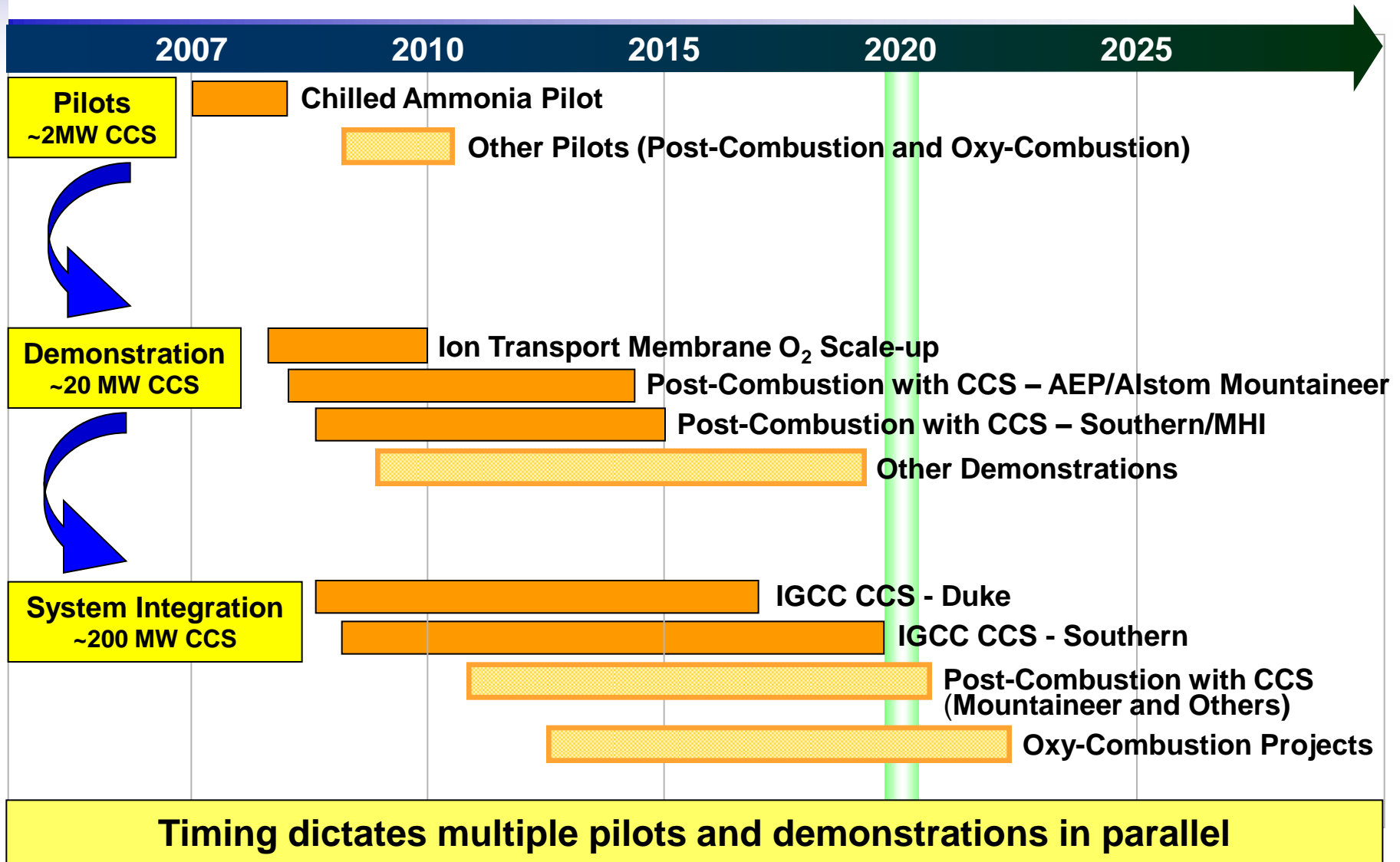
**Henry A. “Hank” Courtright  
Senior Vice President**

**NARUC Meeting  
Sacramento, CA  
July 19, 2010**

# 2009 EPRI Prism Model



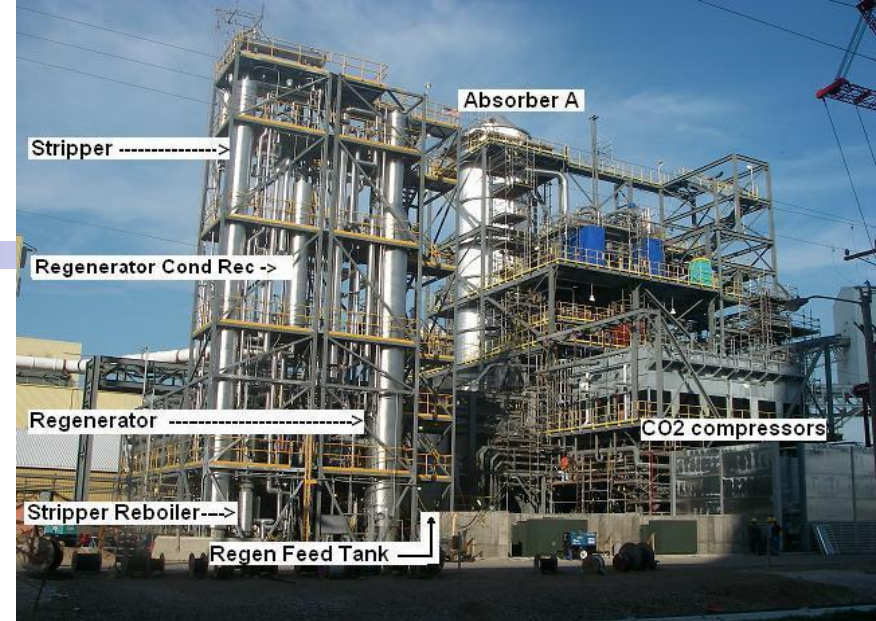
# CCS/Advanced Coal Technology Roadmap



# Pulverized Coal with CCS AEP/Alstom

## Alstom chilled ammonia CO<sub>2</sub> capture process

- ~20-MW<sub>e</sub> demonstration at the Mountaineer Plant
- ~100,000 tonnes-CO<sub>2</sub>/year
- 1- to 5-year injection program plus post-injection monitoring
- Started CO<sub>2</sub> capture in Sept and injection in Oct. 2009
- Developed two CO<sub>2</sub> injection wells
  - AEP-1 Rose Run (7800 ft)
  - AEP-2 Copper Ridge (8200 ft)



All pictures of the Mountaineer CO<sub>2</sub> Capture and Storage Project are the property of Alstom Power and/or AEP

# Pulverized Coal with CCS

## Southern/MHI

- **MHI KM-CDR advanced amine CO<sub>2</sub> capture**
  - **~25-MW<sub>e</sub> demonstration at Plant Barry**
  - **~150,000 tonnes-CO<sub>2</sub>/year**
  - **Injection program under U.S. DOE's Southeast Regional Carbon Sequestration Partnership (SECARB) Project**
  - **8-year program: 4 years injection plus 4 years monitoring**
  - **Start-up scheduled for 1Q 2011**
  - **Storage will be in the Citronelle oil field ~15 miles away**

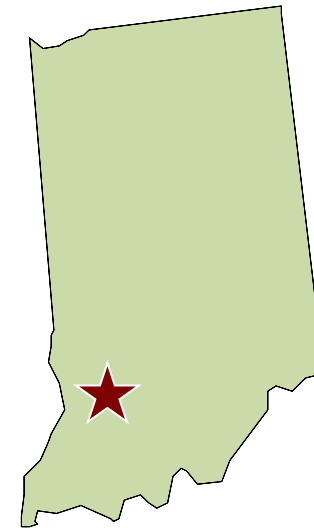


Courtesy: Southern Co.

# IGCC with CCS

## Duke Energy

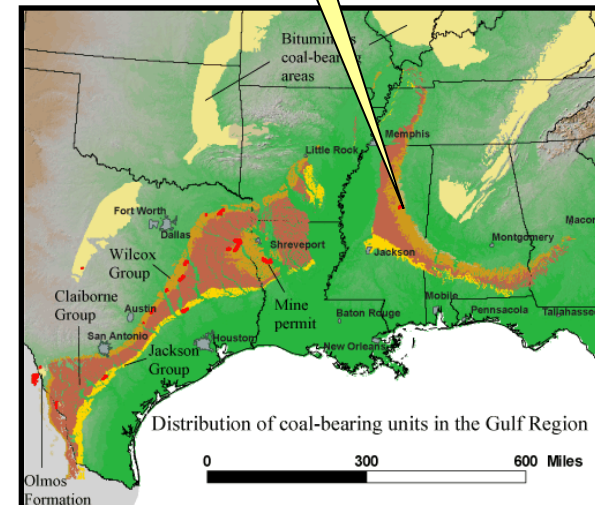
- **DEI / Edwardsport 630-MWe IGCC Plant**
- **Process technologies to be demonstrated**
  - **Physical solvent-based CO<sub>2</sub> capture treating the syngas flow (“skimming”) at a dual-train IGCC unit**
  - **~1,000,000 tons CO<sub>2</sub>/year storage in nearby geologic formation;**
  - **2 year capture and injection demonstration; anticipated to start in 2014-16**



# Kemper County IGCC

## Mississippi Power / Southern Co.

- 2x1 Integrated Gasification Combined Cycle
  - 582 MW peak and 524 MW on syngas
  - ~65% CO<sub>2</sub> capture (~800 lb/MWhr emission rate)
  - Mine mouth lignite – NG Backup
- Owner & operator: Mississippi Power
- Over \$2 billion capital investment
- Commercial operating date: May 2014
- Captured CO<sub>2</sub> used for Enhanced Oil Recovery (EOR)



Courtesy: Southern Co.

# ITM for Low-Cost Oxygen Production

- Ceramic membrane separates oxygen from air
- Planned 100 ton-O<sub>2</sub>/day test unit (ISTU)
- DOE Phase 3 cooperative development program to design, build, and test the ISTU system
- ITM project progress to date
  - Testing of 0.5 ton-O<sub>2</sub>/day modules started in 2006
  - Over 600 days of cumulative operation in multiple runs
  - Testing of 1.0 ton-O<sub>2</sub>/day modules began in Feb. 2010



# ITM for Low-Cost Oxygen Production

## *Acknowledgment and Disclaimer*

### **Acknowledgment**

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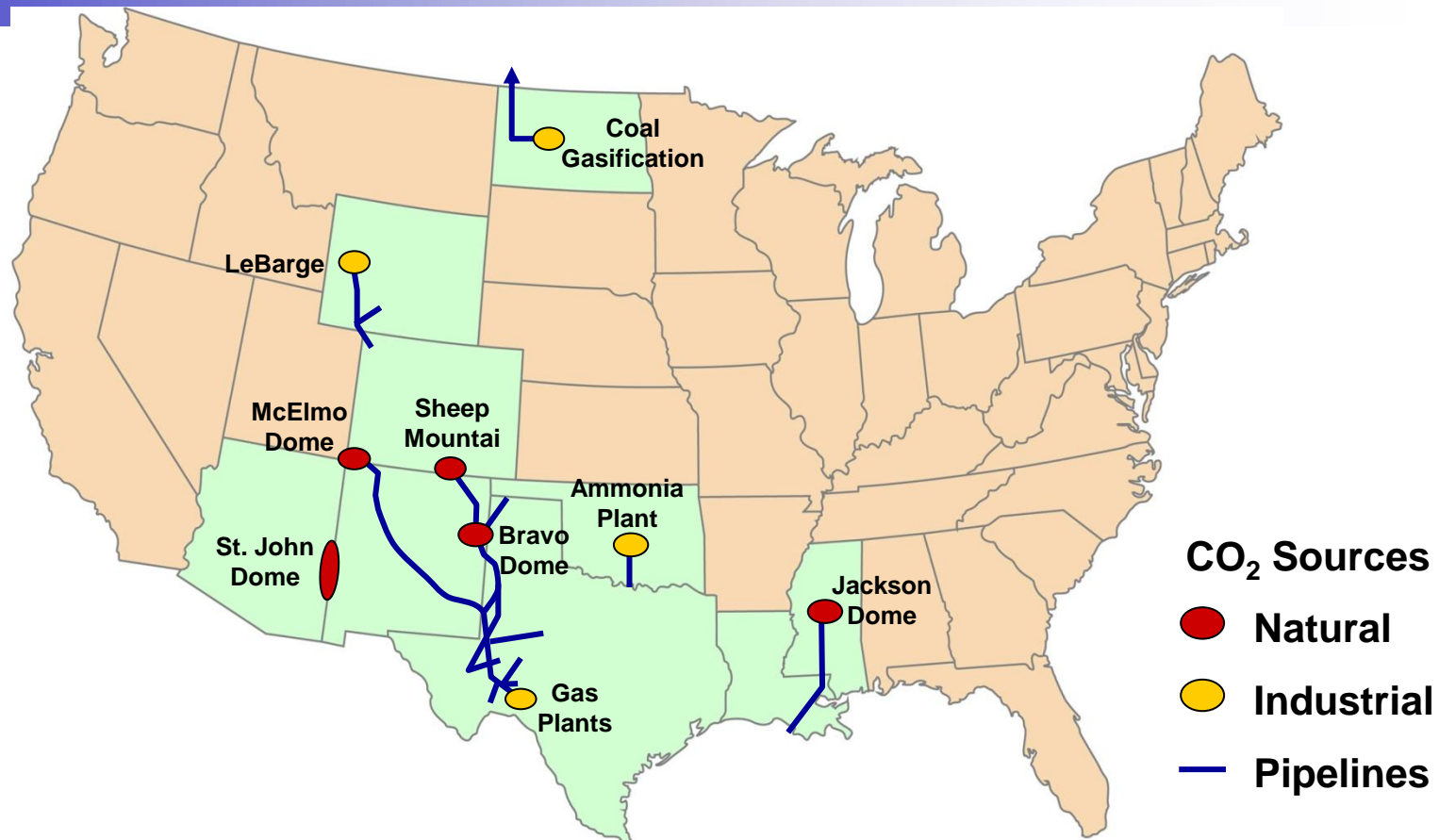
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# CO<sub>2</sub> Pipeline Experience



- Well established – Multiple proven products
- R&D needed for CO<sub>2</sub> mixtures with impurities

# CO<sub>2</sub> Capture and Transport Technology Status

## Technical Readiness Levels

TRL	Post-Combustion Capture	Pre-Combustion Capture	H <sub>2</sub> -Fired Gas Turbine	Oxy-Combustion	Algae Production	CO <sub>2</sub> Compression	CO <sub>2</sub> Pipelines
9		●				●	●
8			●				
7	●		●	●			
6				●			
5							
4					●		
3							
2							
1							

**TRL-9 – commercial**

**TRL-8 – demonstration at >25% commercial scale**

**TRL-7 – pilot plant at >5% commercial scale**

**TRL-6 – process development <5% of full-scale**

**TRL-5 – component validation in relevant environment**

**TRL-4 – component test in lab**

**TRL-3 – proof of concept**

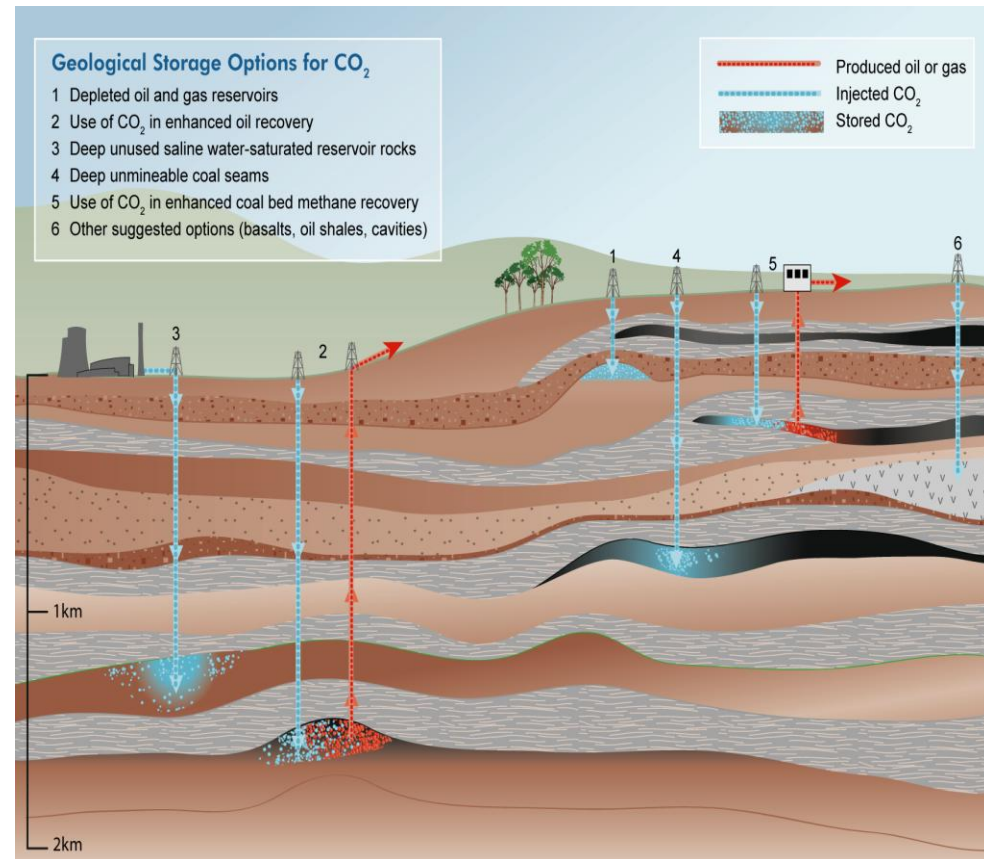
**TRL-2 – application formulated**

**TRL-1 – basic principles**

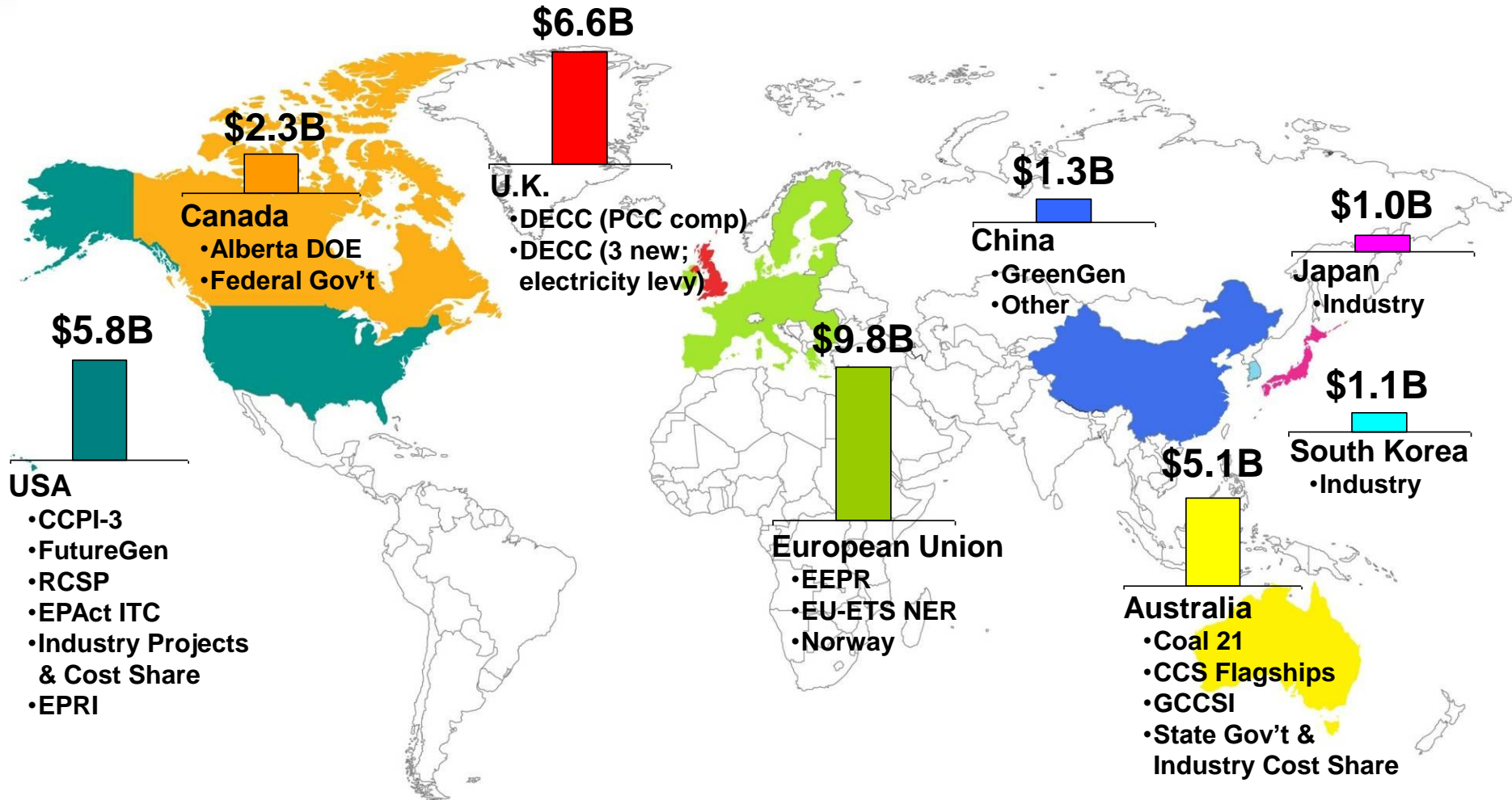
Source Global CCSI Institute

# Key Issues for Geologic Storage – DOE Programs and Others Seek to Resolve

- Site characterization
- Wellbore/Cap-rock integrity
- Injectivity and storage capacity
- Monitoring systems
- Protection of potable groundwater
- Pore space ownership
- Long-term liability

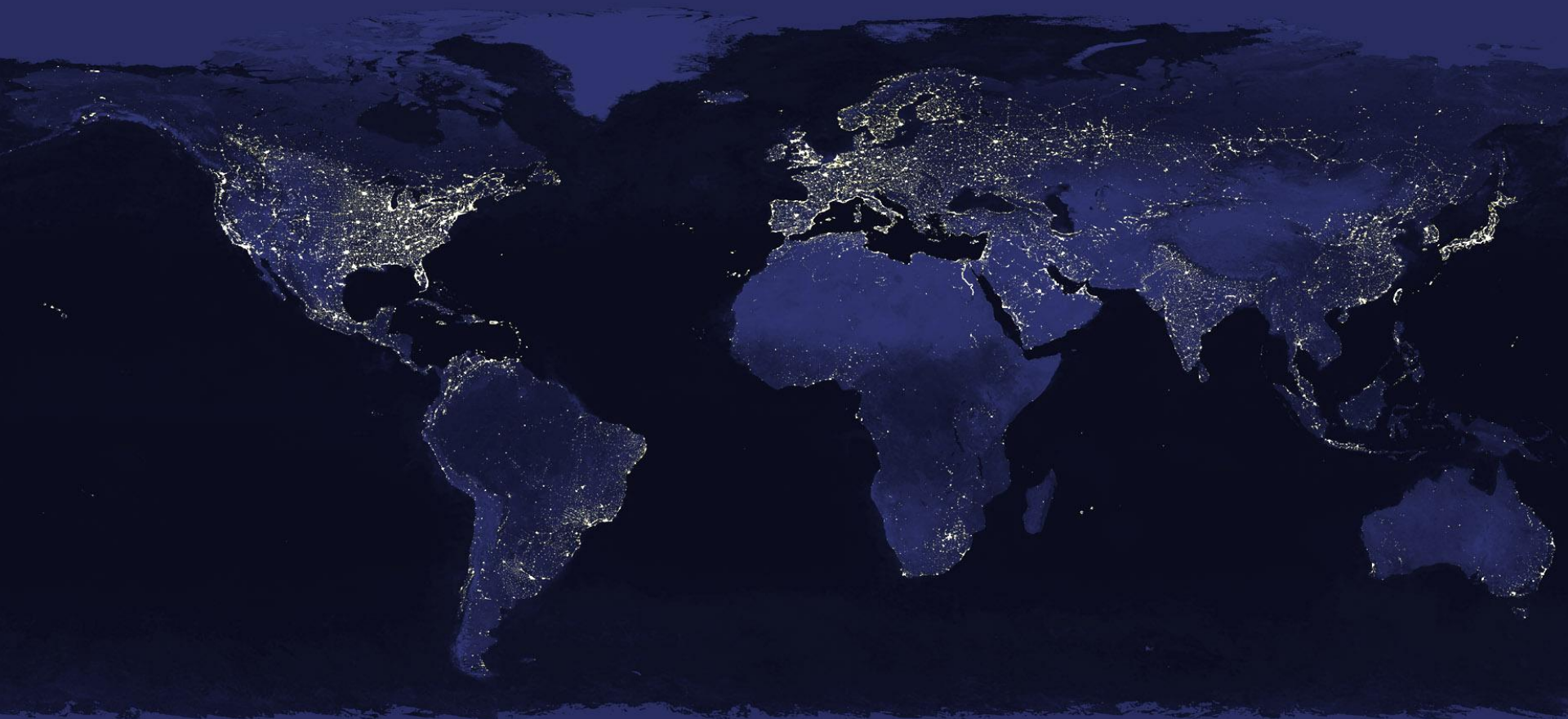


# Power-Related CCS Demonstration Project Funding Worldwide To Exceed US\$30 Billion\*



\* Major government power-related CCS demonstrations and power industry large demonstration projects only

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