

Accelerating CCUS Commercialization Through US-PRC Collaborations: Business, Government, Academia, NGOs

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Clean Air Task Force is a non-profit organization dedicated to reducing atmospheric pollution through research, advocacy, and private sector collaboration.

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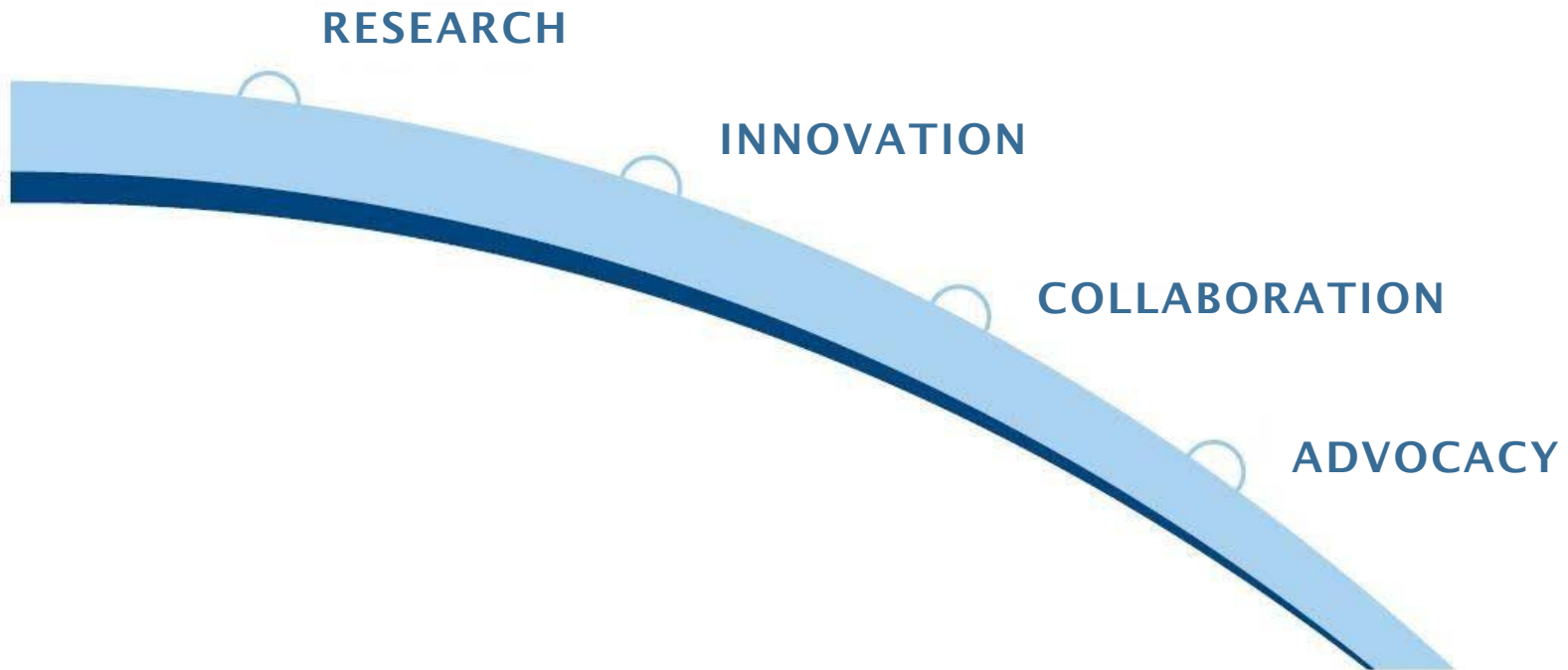
Carbondale, IL

Columbus, OH

Washington, DC

CATF approach

- CATF works to protect the Atmosphere through...



The Climate/Coal Challenge

Coal will remain a significant source of GHG ...

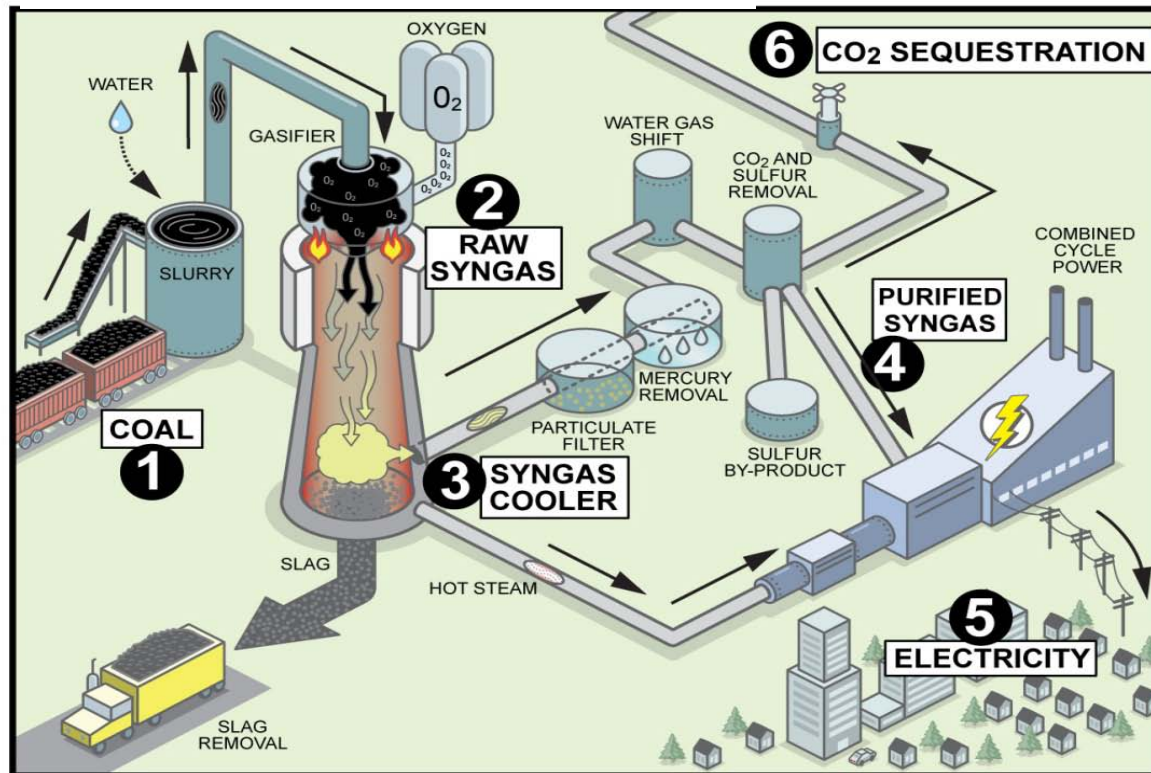
- IEA, DOE EIA, PRC NDRC, and others project that coal will continue to be a key source of energy for years (particularly in China, India, US).
- Coal-fired power generation accounts for about 40 percent of man-made CO₂ emissions from energy use.
- Global warming cannot be seriously addressed without substantial reductions in CO₂ emissions from coal power within the next two decades.

... Unless we deploy CCUS technologies.

- Widespread deployment of **carbon capture, utilization, and sequestration (CCUS)** technology is essential to stabilizing the global climate.

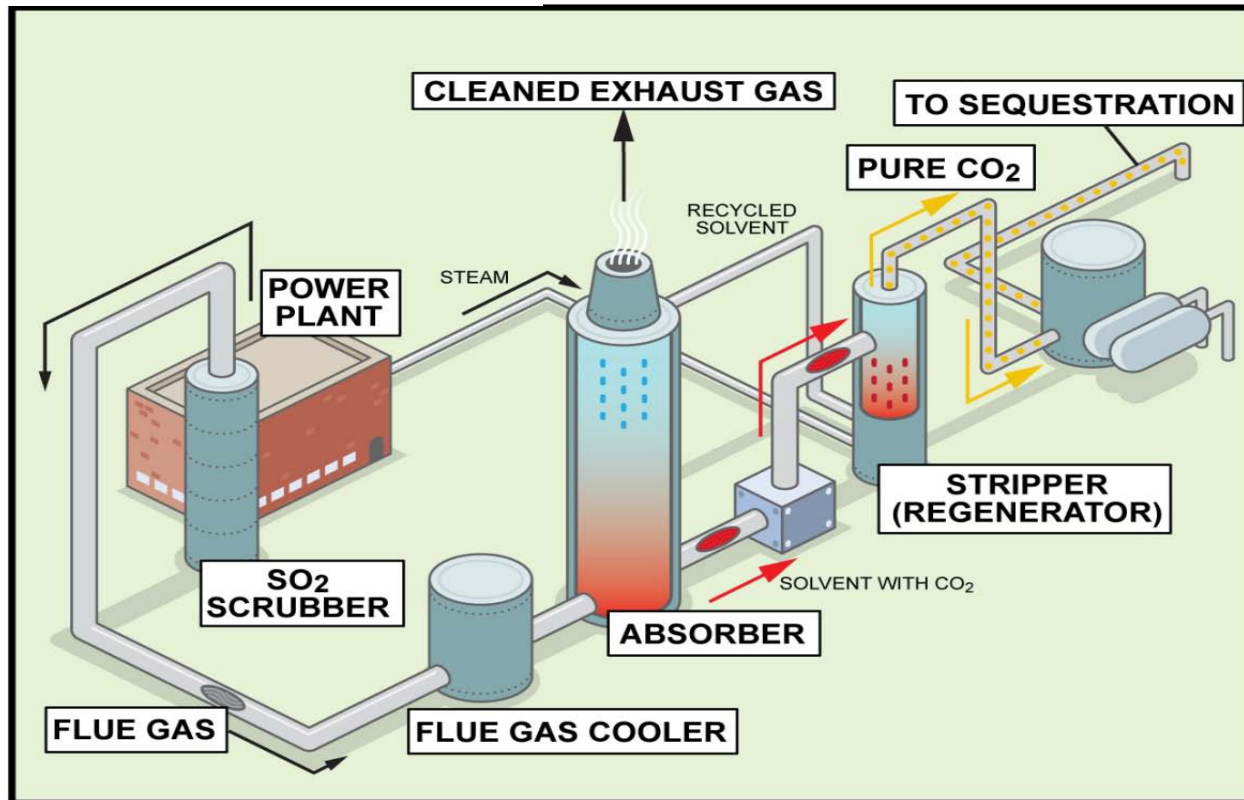
Fortunately, China is a leading developer of key CCUS technology

Advanced Coal Gasification



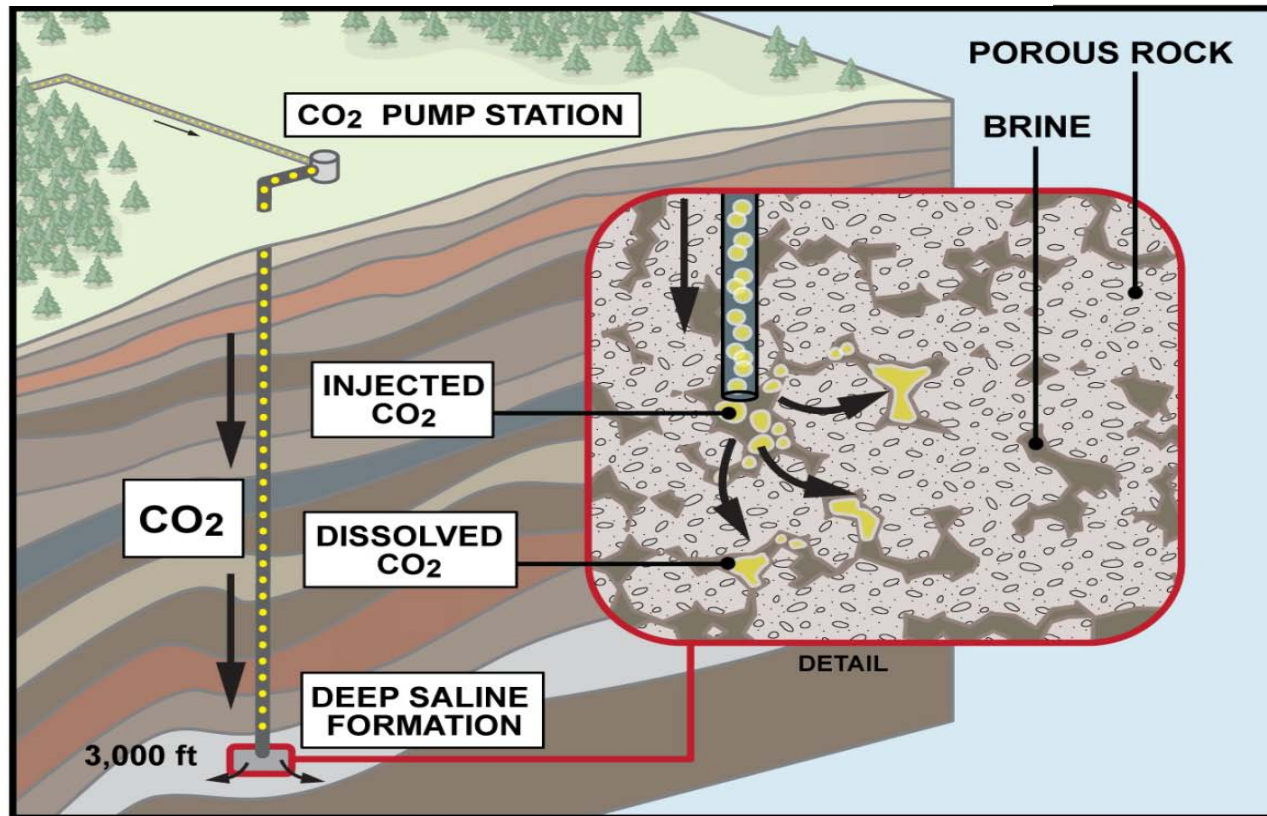
- IGCC: GreenGen IGCC (Tianjin) is setting the pace globally
- Gasifiers: TPRI and ECUST licensed systems to US partners

Post-Combustion Capture



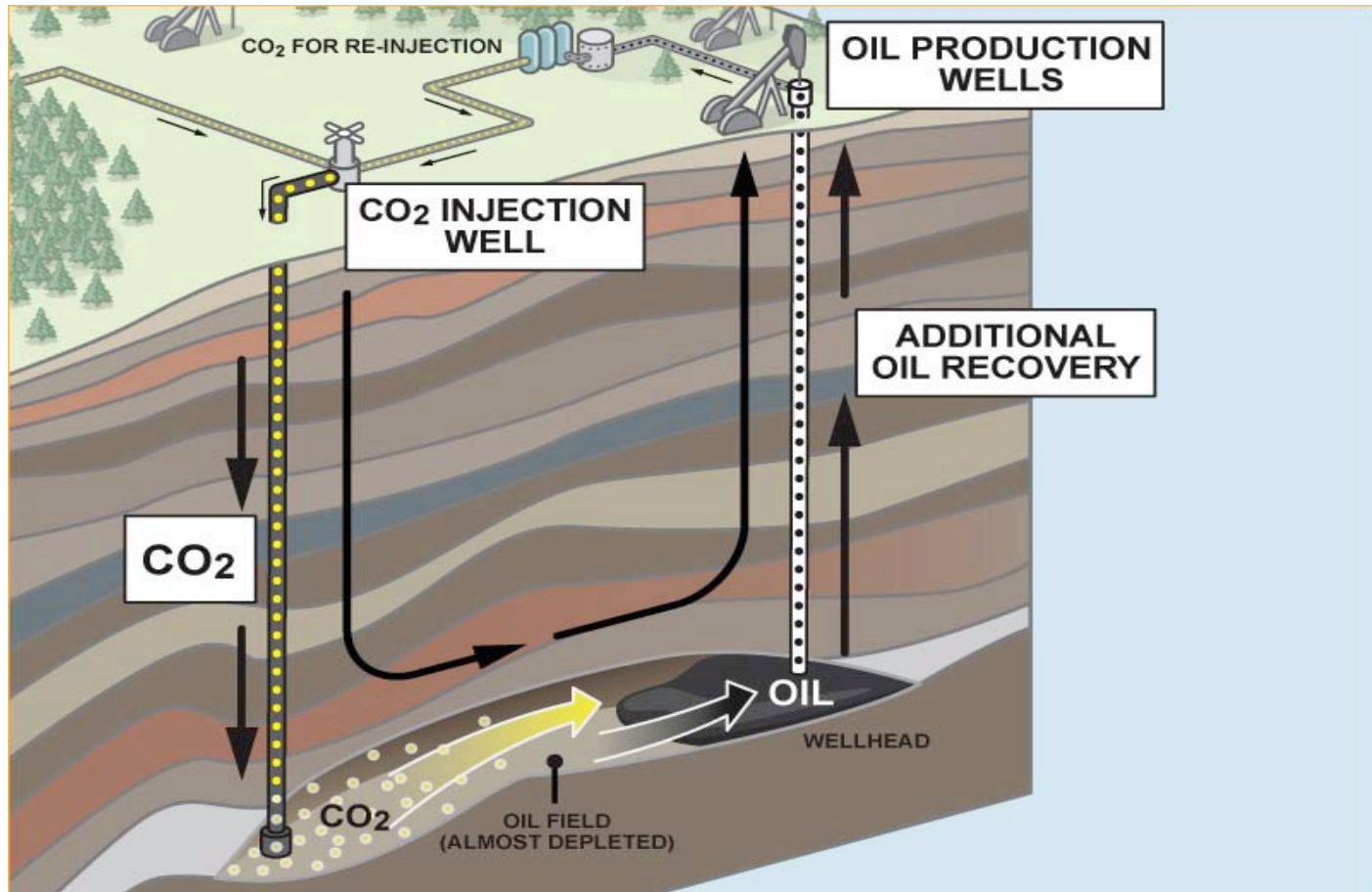
- Huaneng/TPRI Shanghai unit captures 120,000 tpy CO2

Geological Carbon Sequestration



- Shenhua DCL plant (Ordos Basin) will inject 100,000 tpy CO₂
- Potential scale-up to 2.9 million tpy CO₂

Enhanced Oil Recovery



- EOR research projects: PetroChina (Jilin), Sinopec (Shengli)

US-PRC Partnerships Can Accelerate CCUS Deployment

- Energy companies in China and US have enormous experience and expertise working with coal, and are similarly motivated to develop technologies and techniques that will preserve a role for coal in a carbon-constrained world.
- China is the center of the coal gasification “universe” (~80 GW thermal today), and its companies can develop CCS projects quickly (1/3 to 1/5 the US time) and at substantially less cost.
- US is the world leader in geologic sequestration: it injects 30 million tons of CO₂ each year for enhanced oil recovery and is undertaking large-scale saline aquifer CO₂ injection projects.
- Investments by one country can reduce the cost of a technology worldwide, increasing the likelihood that CCUS will be widely deployed in time to help avert the worst consequences of climate change.

Overview of CATF US/Asia CCUS Work

- CATF launched its international advanced coal technology/CCS business-to-business effort in 2007.
- CATF co-founded two related organizations to promote our work in Asia: the Asia Clean Coal Initiative (established 2007) and the Asia Clean Energy Innovation Initiative (established 2009)
- Result: several partnerships between innovative US/PRC energy companies, in which CCUS projects are being explored.





TPRI

THERMAL POWER RESEARCH INSTITUTE



Future Fuels



Select partnerships facilitated by CATF

| JV Agreements | Scope of Agreement |
|---|--|
| ZEEP - ENN Group | Deployment of P&W Rocketdyne gasification system. |
| Southern Company/KBR – Dongguan Tiaming Electric Power Company | Deployment of TRIG gasifier. |
| Duke Energy – ENN Group | Joint work on a range of climate technologies including UCG, CCS, solar, and algae biofuels; ENN investment in Duke solar-PV projects. |
| BrightSource - TPRI | Solar-thermal technology development and application in China. |
| Duke Energy – China Huaneng Power/TPRI | Advanced coal generation, CCS including post combustion capture, GCS/EOR, and renewable energy – including wind, biomass and solar. |
| Future Fuels - Thermal Power Research Institute (TPRI) | North American licensee for TPRI gasifiers, application of TPRI-designed gasifier at proposed IGCC projects in US and EU. |
| Others parties under discussion include CNOOC, GreatPoint Energy, General Compression, etc. | |

US and China: Partners in a **Global** Multi-Stakeholder Effort

- The Carbon Capture, Use and Storage Action Group Under the Clean Energy Ministerial, formed June 20, 2010
 - Government partners: Australia, Canada, **China**, France, Germany, Japan, Korea, Mexico, Norway, South Africa, the United Arab Emirates, the United Kingdom, and the **United States**
 - Business and institutional partners: Aker Clean Carbon, the Carbon Capture and Storage Association, the Center for American Progress, Global Carbon Capture and Storage Institute, the International Energy Agency, Sasol, ScottishPower, Shell, the World Coal Institute, and the World Resources Institute

Collaboration in

- The Carbon Sequestration Leadership Forum
- APEC Expert Group on Clean Fossil Energy (EGCFE)
 - Projects on Geologic Storage Potential and on Capture Readyness
- The Asia Pacific Partnership CCS Task Force
 - 17 Projects
 - Tsinghua-WRI project
- The Global Carbon Capture and Storage Institute

Bilateral U.S. – China Cooperation

- US-China Science and Technology Cooperation Framework Agreement, 1979
- Department of Energy – MOST Protocols and Annexes under the S&T Agreement (Fossil Energy since 2001)
- Energy Policy Dialogue (2004)
- 10 Year Framework on Energy and Environment, 2008
- MOU to Enhance Cooperation on Climate Change, Energy & the Environment 2009

New!

U.S.-China Clean Energy Research Center

- DOE-MOST-NEA, 2009
- 3 Centers: CCUS/Clean Coal, Building Energy Efficiency and Clean Vehicles
- \$150M over 5 years from governments and industry
- CCS Consortium selected for US side – University of West Virginia-led, members: Lawrence Livermore and Los Alamos National Labs, the Universities of Wyoming, Kentucky and Indiana, the World Resources Institute, the US-China Clean Energy Forum, General Electric, Babcock & Wilcox, Duke Energy, LP Amina and American Electric Power

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