Technology Development at the US National Carbon Capture Center

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DOE National Carbon Capture Center
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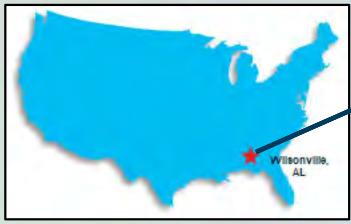
CSLF Annual Meeting
Paris, France

NATIONAL CARBON CAPTURE CENTER

National Carbon Capture Center



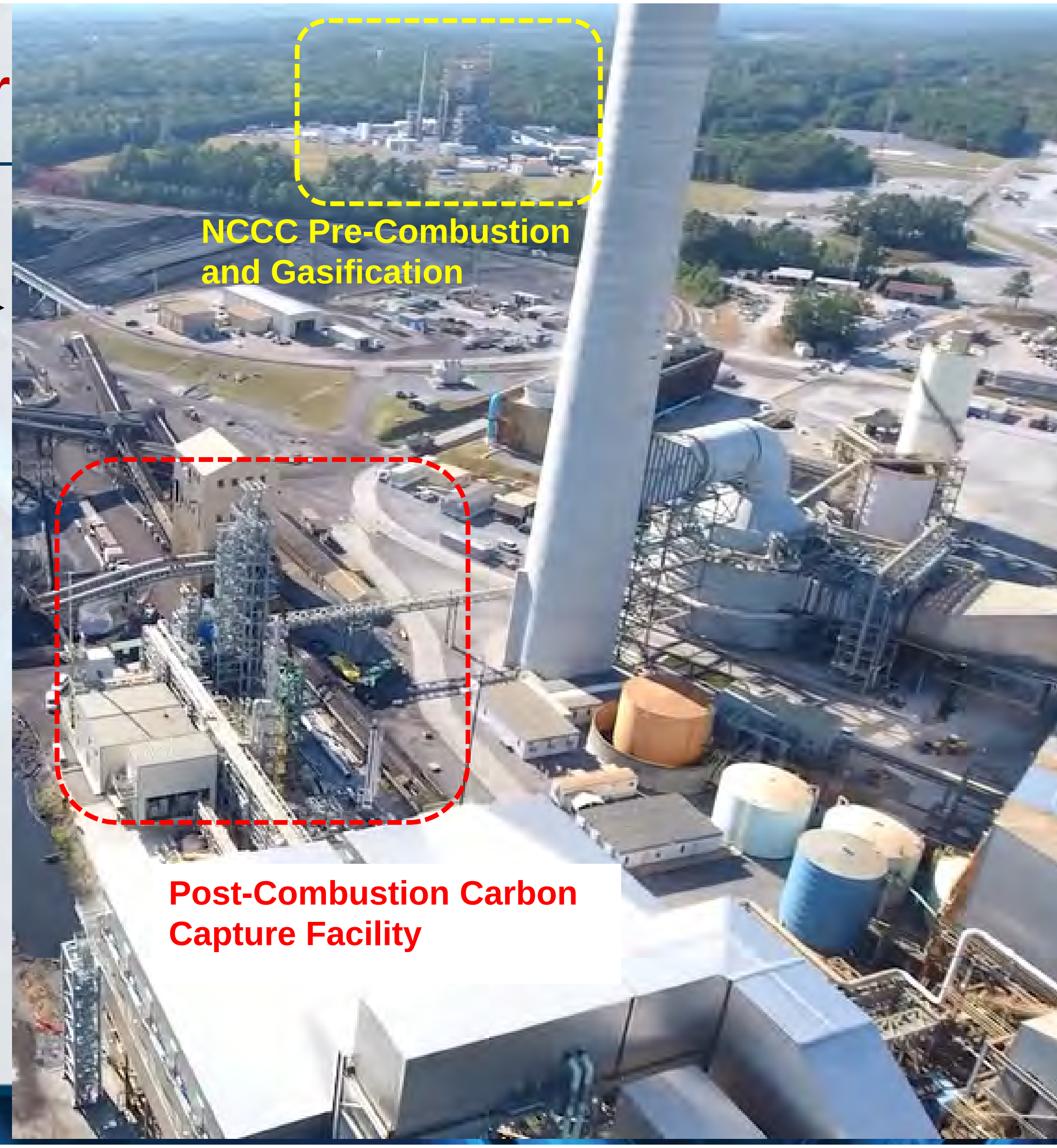
U.S. Department of Energy · NETL National Energy Technology Laboratory · Southern Company · American Electric Power · ClearPath · EPRI Electric Power Research Institute · ExxonMobil · NRECA · Peabody · TVA · Total · Wyoming Infrastructure Authority

2014 - 2020

DOE & Industrial Sponsors 80/20 $187.5 million

- Continue CO_2 Capture R&D for Cost Reduction

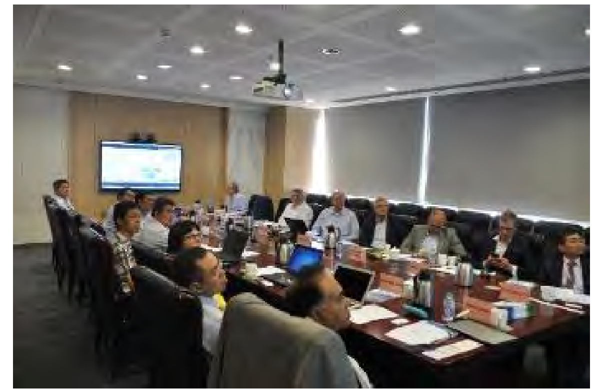
NC National Carbon Capture Center



Alabama Power Plant E.C. Gaston

International Test Center Network

- Share pubic knowledge with carbon capture test facilities
  - Facility operations
  - Facility funding
  - Safety
  - Analytical techniques
- One technical focus area per year
  - Recent: Amine carry-over, support of CCSI, open-access technology, alternative baselines to MEA
  - Next: Reclaiming optimization, Process intensification, CCUS flexible operation, International standardization, Focus technologies other than solvents, Utilization testing and business strategy, Industrial capture - especially steel



ITCN Members

Additional Benefits of ITCN

- Establish relationships that will set groundwork for partnerships for scale-up
- CCS support is inconsistent, ITCN attenuates swings
- Technologies more robust with broad requirements
- Provide input to governments, sponsors and developers into status, roadmaps and policy
- Encourage passionate participants to stay in the field


UKPACK


SINTEF


CERI

Tracking Progress of CSLF Technology Roadmap - Capture

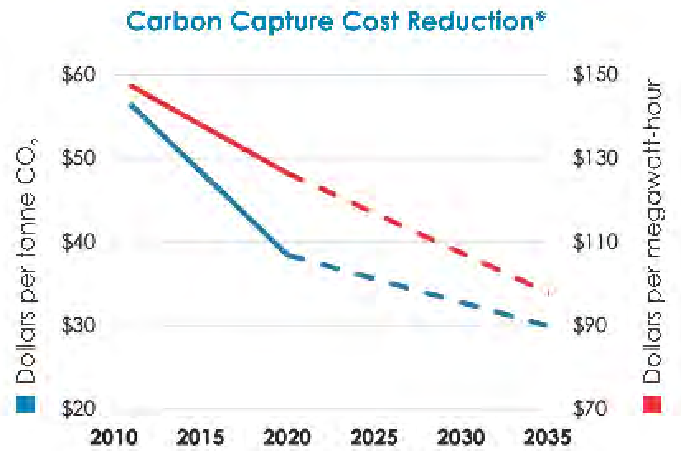
Government and Industry should work together toward:

- Reduce the avoided carbon cost (or capture cost) in dollars per tonne of CO_2 ($/t$CO_2$) of currently available commercial CO_2 capture technologies for power and industry by at least 30%, while at the same time minimizing environmental impacts.
- Establish a network for knowledge sharing among full-scale facilities (e.g., by expanding the existing International Test Centre Network to share knowledge and experiences and increase understanding of the scale-up challenge).
- Resolve issues mentioned in section 3.1.2 regarding industrial CO_2 capture and bio-CCS and further develop technologies for applications and implementation in pilot plants and demonstrations.
- Increase possibilities for testing at the large pilot and demonstration scale by facilitating planning and construction of more test facilities for technologies other than solvent-based technologies.
- Fund and encourage RD&D activities for new and promising capture technologies.
- Increase activities on large-scale production of hydrogen with CCS, with the aim to develop this as a serious option in the 2025–2030 time frame.

Tracking Progress of CSLF Technology Roadmap – Item 1

Reduce the avoided carbon cost (or capture cost) in dollars per tonne of CO2 ($/tCO2) of currently available commercial CO2 capture technologies for power and industry by at least 30%, while at the same time minimizing environmental impacts.

Already reduced projected cost of carbon capture from fossil generation by 1/3 using NCCC Results



Status:
Confidence that cost and performance improvements are real is growing from extensive testing at a scale under 10 MW. Sharing results from large test facilities is needed.

Yellow

Tracking Progress of CSLF Technology Roadmap – Item 2

Establish a network for knowledge sharing among full-scale facilities.

- ITCN is establishing relationships with projects that are scaling up.
  - Norway, Middle East, China, India
- ITCN is establish relationship with organizations planning scale-up
  - CERC, NPC and other studies, Kemper final report through DOE …
- Make best use of available scale-up information at sizes less than full-scale
  - Projects moving from NCCC to TCM with a 10X scale-up. Deep dive knowledge exchange

Yellow

Tracking Progress of CSLF Technology Roadmap – Item 3

Resolve issues regarding industrial CO_2 capture and bio-CCS and further develop technologies for applications and implementation in pilot plants and demonstrations.

- High costs – Response: Costs under specific industrial conditions are being reduced, but more large projects that will share knowledge are needed to reduce cost risk.
- Levels of uncertainty regarding investments – Response: Government-private partnerships are growing, but more, larger projects are needed soon.
- Environmental impacts as well as health and safety implications regarding waste products and toxicity – Response: The growing number of commercial and R&D projects each required environmental certification. This should be part of the knowledge sharing.
- Increased operational complexity and risks (integration, hidden costs of additional downtime, alternative product supplies, and technology lock-in; these will be site-specific) – Response: Each project, now matter how small that is operated under industrial conditions is important to understand the complexity of developing cost-effective, commercial products.
- New applications of existing technologies that are not yet proven at scale – Response: Most successful commercial projects adapt existing technologies to local process requirements. More large projects are needed soon.
- Understanding the impact of different compositions of the feed and/or flue gases compared to the power sector – Response: Any test facility will report that operating with real flue gas will very often lead to strong lessons learned for a design developed under lab conditions. More funding for testing needed to support large projects.

Status: Green, far-reaching improvements under development by CCUS R&D community and private partners moving forward with commercial designs, but more, larger projects needed to address climate change.

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Tracking Progress of CSLF Technology Roadmap – Item 4

Increase possibilities for testing at the large pilot and demonstration scale by facilitating planning and construction of more test facilities for technologies other than solvent-based technologies.

- More large-scale projects needed faster.
- More cost-effective to test low TRL, non-solvent technologies at smaller scale first.

Red

Tracking Progress of CSLF Technology Roadmap – Item 5

Fund and encourage RD&D activities for new and promising capture technologies.

- Growing optimism for R&D support for promising technologies. DOE continues to be generous in support of NCCC.

Green

Future Developers at the NCCC

Developer	Technology Description	Technology	Scale
Huaneng CERI	Blended amine solvent (HNC series)	Solvent	Pilot-PSTU
ION Engineering	Validation of Transformational CO_2 Capture Solvent Technology	Solvent	Pilot-PSTU
GTI	Rotating Packed Bed Solvent (ROTA-CAP)	Solvent	Bench
GTI	Graphene Oxide (GO) Membrane	Membrane	Bench
MTR	Self-assembly Isoporous Supports Polymeric Membrane	Membrane	Bench
OSU	Novel Transformational Membranes and Process	Membrane	Bench
SUNY Buffalo	Rational Development of Novel Metal-Organic Polyhedra-Based Membranes for CO_2 Capture	Membrane	Bench
PCI	High Capacity MOF Nanosorbents	Sorbent	Bench
LBNL/Inventys	Inventys Sorbents and LBNL amine-appended MOFs Sorbents	Sorbent	Bench
Rensselaer Polytechnic Institute	Transformational Molecular Layer Deposition Tailor-Made Size-Sieving Sorbents	Sorbent	Bench
CO_2 Utilization Developer	**Technology Description**	**Product**	**Scale**
Southern Research	Thermocatalytic Ethylene Production Process Using Ethane and Coal-Fired Flue Gas CO_2	Ethylene	Bench
UCLA	Upcycled CO_2-Negative Concrete	Concrete	Bench
Helios-NRG	Novel Algae Technology to Utilize CO_2 for Value-Added Products	Algae	Bench

Questions