>> FOSSIL FORWARD

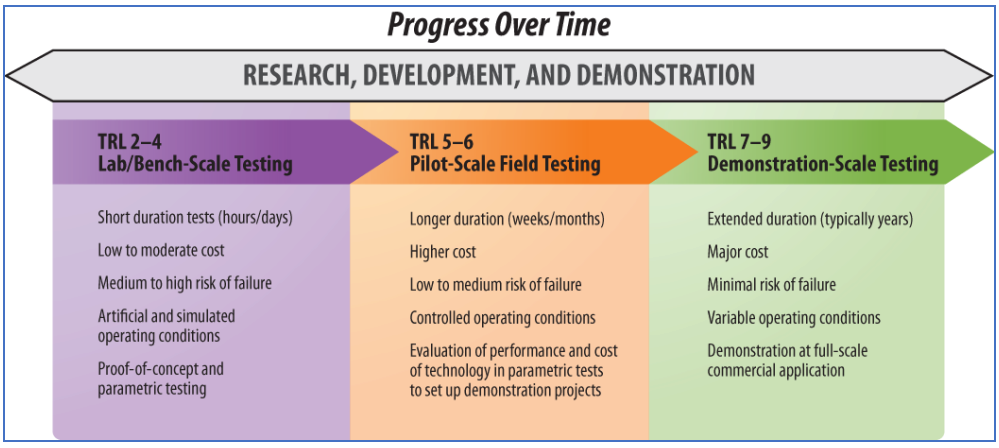
Revitalizing CCS: Bringing Scale & Speed to CCS Deployment

Chapter C – Status & Achievements of Current CCS/CCUS Programs

Status and Achievements of Current DOE CCS/CCUS Programs

The U.S. Department of Energy (DOE) launched its carbon capture and storage (CCS) program in 1997 with $1 million in funding. The program supported significant efforts to develop and advance carbon capture technologies for both pre- and post-combustion capture, and added a dedicated post-combustion capture program to support development of CCS retrofits to existing plants. Today, the DOE CCS R&D program has grown to a $200+ million annual program with a portfolio of nearly 200 projects across the CCS chain in various stages of development.

The DOE CCS R&D program has traditionally maintained two areas of focus: Carbon Capture and Carbon Sequestration, including Enhanced Oil Recovery (EOR). DOE programs support R&D, pilot scale testing, and commercial scale demonstration and currently focus on two core research technology areas: post-combustion capture and pre-combustion capture. The program is focused on developing second generation and transformational CO_2 capture technologies that could provide significant reductions in both cost and energy penalty compared to present day, first generation technologies.



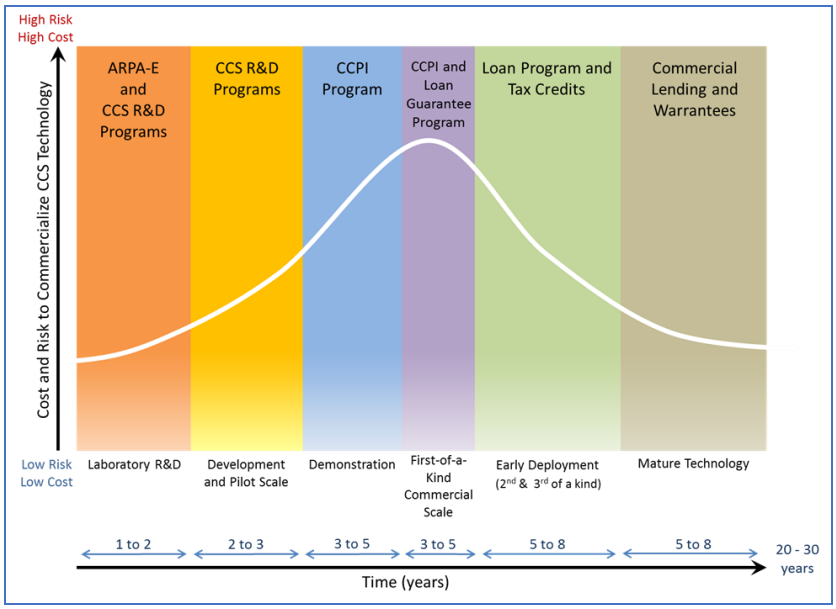
Stages of CO_2 Capture Technology R&D

The original Carbon Capture program goal was to have 90% CO_2 capture with 99% permanent storage for a no more than a 10% increase in the cost of services by 2012.[1] These program goals are not the kind of goals that would be set by the private sector, which must envision a path through to commercial application within a reasonable timeframe in order to justify a return on investment. At best, the DOE programs are intended to bring technologies to the point of large-scale demonstration.

Pilot scale testing is critical for validation and development to move to commercial scale, but the current DOE program structure does not support large-scale pilot projects. While initial laboratory scale data is relatively low cost, pilot work is more expensive and considered a high-risk endeavor both technically and financially due to the uncertainty of technologies. Pilot project budgets are cost prohibitive for small technology development companies and not palatable for larger firms uncertain of the return on investment.

[1] National Research Council, "Report of the Panel on DOE's Carbon Sequestration Program", 2007

The DOE Loan Guarantee Program was authorized by the Energy Policy Act (EPAct) in July 2005, which allows loans for up to 80% of total project cost. Loan funds are drawn in tranches based on specific technical and equity funding milestones. While the program provides significant assurance financially and lowers borrowing costs, it does not cover technology risk or performance risk. These risks need to be satisfied to as the lack of guarantees causes an inability to finance certain projects, resulting in significant and costly delays. Underwriting of loans entails a more extensive analysis of technical, policy and market factors *over the life of the loan* compared to grant applications, which focus primarily on technical milestones and objectives. Given ongoing constrained capital market conditions, the DOE Loan program remains vital and is one of two programs in place to support the continuum for moving from early research to FOAK demonstration projects.



Energy Technology Development Spectrum to Commercialize Technology for CCS

Key Findings

- **Significantly more CCS/CCUS pilot and demonstration projects are needed in order to commercially deploy the technology.** Without demonstration there can be no commercialization of CCS/CCUS.
- **It is impossible to objectively assess progress against the DOE program goals.** Goals are overly optimistic in terms of both level of performance and cost, along with the projected time to accomplish commercial demonstrations.
- **Funding for DOE Programs is Inconsistent with DOE goals.** DOE programs have consistently been inadequately funded and significant federal financial support will be necessary for successful development, demonstration, and deployment of CCS.
- **CCS technology is not commercially available at large power plant scale.** The state of CCS development within DOE establishes that CCS is not commercially available at this time.
- **Opportunities to exploit CO_2 for EOR applications to expedite CCS/CCUS technology are hampered.** Projects that couple EOR with CO_2 storage have better economics and typically a higher chance for success than CCS projects with just storage. While EOR has been successfully demonstrated, the possibility of safe storage and monitoring, verification, and accounting to support a CO_2 EOR storage system, still face unresolved regulatory issues in the U.S. that could impact EOR project development.[2]

http://www.nationalcoalcouncil.org/studies/2015/Fossil-Forward-Revitalizing-CCS-NCC-Approved-Study.pdf

[2] http://water.epa.gov/type/groundwater/uic/class6/upload/epa816p13004.pdf