CCUS Update USEA Seminar

June 24, 2025

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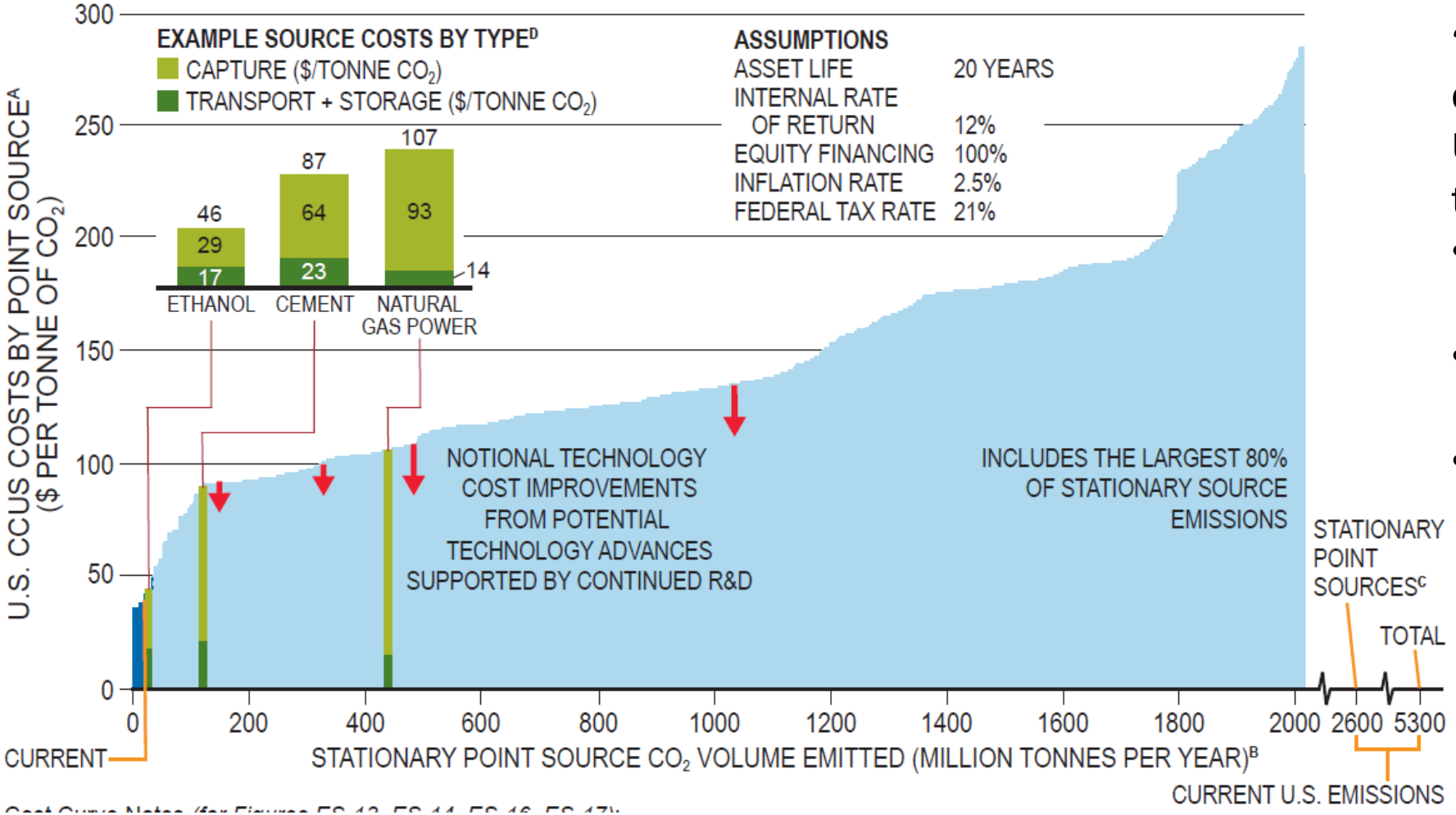
Big Picture: Headwinds, but All is Not Lost

1. **What's the goal?** Are we trying to incentivize CCUS enough to scale or to get some wins on the board.
2. **What would it take to scale?** Results of detailed cash flow modeling
3. **What projects may succeed given today's politics?**
4. **What about EOR?**
5. **Transferability**

Vision of CCUS at-scale: NPC 2019



"To achieve CCUS deployment at scale, the U.S. government will need to

- Reduce uncertainty on existing incentives
- Establish adequate additional incentives
- Design a durable regulatory and legal environment that drives industry investment in CCUS."

NPC Exec Sum p. 21

NPC "Meeting the Dual Challenge" 2019, Figure ES-123

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2024 Favorable/Unfavorable Assumptions for NOAK: 12 Yr. 45Q*

- Full corporate after-tax project cash flow models for Nth-of-a-Kind. Here we are using example of a 12-year 45Q payment and raising the level of the 45Q (in $/t captured) to get to a 13.5% after equity return on project for the owner. (~$35 higher need than beginning 2021).
- Key assumptions: O&M is 5% of original capital investment cost, sequestration is $30/t, debt rate is 6% balance sheet/7.5% project with 12-year level amortization, & minimum Debt Service Coverage of 2.0x

	Profitable Corporation (can use O&M, depreciation, interest deductions)	**Standalone Project/Tax Equity** (higher debt cost, less efficient use of deductions)
$400/tpy Lower End of NOAK Equipment Cost** (cement, baseload coal)	$109	$118
$600/tpy Higher End of NOAK Equipment Cost** (FCCU, pulp mill, NGCC baseload)	$140	$153

$130

* From work sponsored by Carbon Capture Coalition, 2025.

Projects that May Succeed Despite Headwinds

Bucket	Project Types	Headroom/(Deficit) vs. $85/tonne * GS
Existing & Cheap	Ethanol & Natural Gas Processing	+~$25-30 headroom
Greenfield & Cheap	Blue Ammonia: auto-thermal CH4 reforming → export ammonia	+~25-30 headroom (but none completed)
Out-of-the-money but motivated	Cement for global companies w/ carbon goals (Heidelberg)	($40-50?) FOAK wounded by end of grants
Very difficult, but motivated and special situations	Natural gas co-gen or NGCC w/ motivated offtaker/baseload (CalPine)	($75) FOAK wounded by end of grants

*Including modest pipeline distance and decent GS within pipeline range. I.e., not Summit Carbon Solutions, whose related projects are a major part of those listed in “advanced development”.

What about EOR?

- EOR has fallen out of favor in discussions; but EOR @ $85 has far better economics, relies on existing pipelines and wells.
- Keep-it-in-the ground school of thought derides CCS-for-EOR; others maintain that CCS-EOR can sequester as much CO2 as the produced oil emits. Far better than tar sands or heavy crude.

	CCS + Geologic Sequestration	CCS + EOR
Cost of Capture	($100)	($100)
Cash in from 45Q	$85	$85
Plus Cost of GS	($20)	$0
Cash in for CO2 Sales to Oil	$0	$20
Net Cash Flow (Deficit)	($35)	$5

For as Long as We are Burning Oil and Have Fossil Power Plants, CO_2 EOR is Environmentally Solid

Each System Produces 3MWh & 1.8bbl; One System is 0.9 tonnes less CO_2

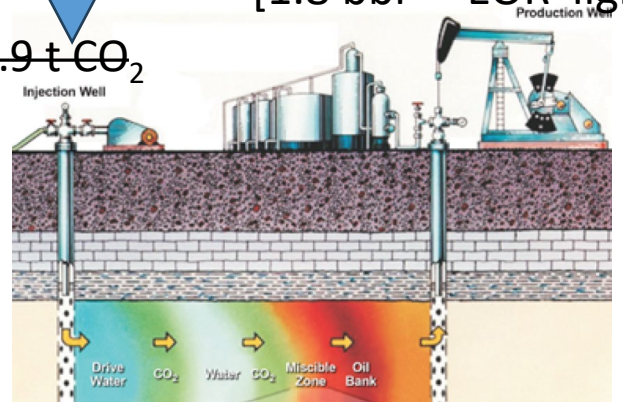
+1 t CO_2
[3 MWh]

= +0.9 t CO_2*
[1.8 bbl primary oil]

+0.1 t CO_2
[3 MWh]

+0.9 t CO_2
[1.8 bbl** EOR light oil]

~~+0.9 t CO_2~~



~~(-0.9) t CO_2~~

UNABATED SYSTEM EMISSIONS
= **+1.9 t CO_2***

CCS ABATED SYSTEM EMISSIONS
= **+1.0 t CO_2**

*Typical figures for emissions from 1bbl intermediate crude (such as WTI), including transport & processing = 0.5t/bbl (or 0.9t /1.8bbl) for intermediate crude—conservative. If CO2-EOR lighter oil displaces production of California heavy crude or Alberta tar sands, there is an extra benefit of CO_2-EOR (about +0.4t CO_2 lifecycle savings per 0.9t captured CO_2 injected). That is because those heavy crudes typically emit ~0.2t/bbl more than intermediate crude. ** Typical CO2 productivity = approx. 2 bbl oil yield per ton CO_2 purchased and injected. Actual figures are trade secrets.

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Transferability: Obscure Issue/Hugely Important

- How easy (or hard) it is to *use* §45Q is as important as the dollar amount.
- Projects, on their own, don't become federal taxpayers for 10-20 years (depreciation and interest deductions wipe out taxable income)
  - This doesn't mean these are lousy projects in the real world.
  - *It means Congress gives big, capital intensive projects a lot of tax benefits even without the credits.* So, the projects "look unprofitable" to the IRS.
- "Tax equity" deals allow a high-taxpayer party to join as a partner, and for the tax credits to be disproportionately directed to that high-taxpaying partner for a limited time—long enough to use up the §45Qs.
  - This is a real partnership ownership, for a lot of money, locked in for many years. Inflexible if that partner's situation changes (has terrible business years and is losing money).
- Transferability gives the partner a bailout option. Sell to another company.
- Transferability is the only reason the tax equity market has been able to grow in the last few years.
  - Wiping out transferability would be terrible: directly and by exacerbating the already poor reputation the US has for policy certainty.