Institute for Energy Economics and Financial Analysis

Debunking Myths About Carbon Capture

CCS Deep Dive for Journalists

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What Is Carbon Capture and Sequestration (CCS) and Why Is It Now Such a Big Issue?

CCS is touted as key part of reducing emissions of CO_2 from fossil-fired power plants, hydrogen production facilities, and certain large industries that that would otherwise be emitted into the atmosphere.

All, or very nearly all, of the CO_2 produced by any of these facilities will have to be captured and promoters claim CCS technology is proven.

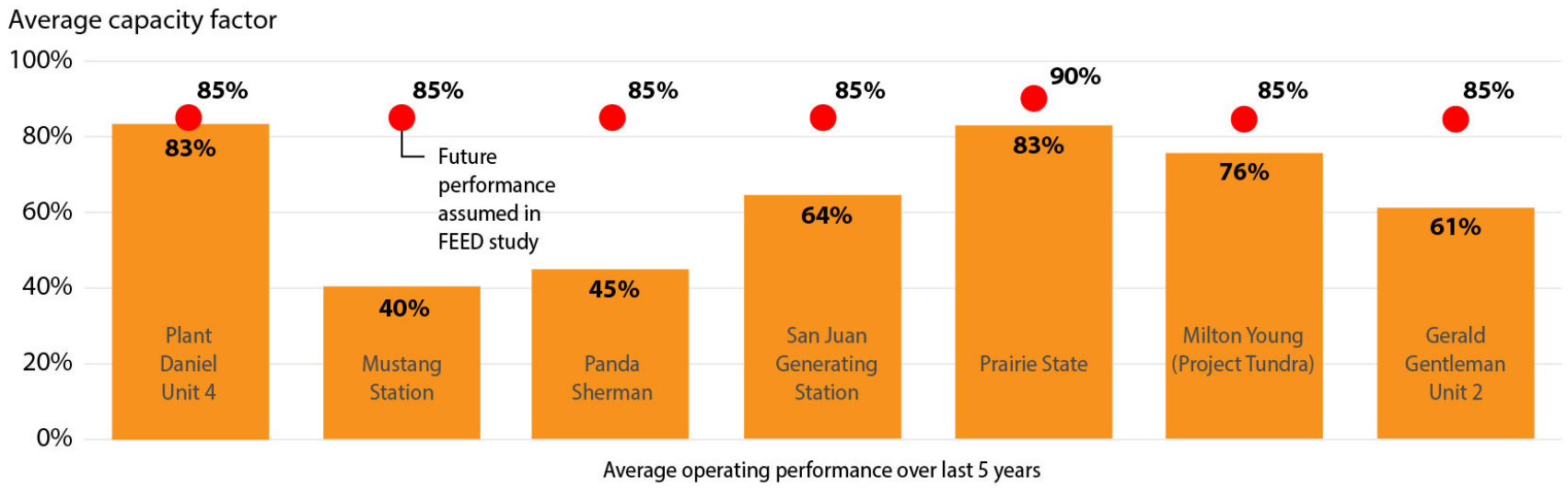
Key questions:

1. Can CCS reliably capture >95% of the CO_2 produced by a plant?
2. Will CCS be financially viable without massive, permanent government subsidies?
3. Can we be certain CO_2 stored "permanently" underground actually will stay there?
4. Are there cheaper, more reliable, and faster options for decarbonizing the economy?

Section 45Q Subsidies for Carbon Capture Provides Incentives for the Production of More CO_2, Not Less

- Under 45Q plants are **incentivized to become CO_2 factories**, "farming for CO_2 subsidies"
- CO_2 capture rates: **$85 per tonne** (metric ton) stored underground**; $60 per tonne** used, (including use for Enhanced Oil Recovery)
- The **more CO_2 captured = the more $$ to owners** from U.S. taxpayers
- **No requirements** that project captures all, or nearly all, of CO_2 it produces
- The amount of CO_2 captured depends on two factors:
  - How much CO_2 is produced
  - How much of that CO_2 is captured and either stored underground or used

Plant Owners Assume Plants Will Run More in Future to Produce More CO_2 and Higher Profits for Them from 45Q Subsidies



***Capacity Factor**: Measure of how much power the plant actually produces versus how much it would have produced if it had operated at 100% power for all of the hours of the time period being looked at – month, year, or series of years*

Retrofitting Existing Plants for CCS Will Take Years

- Designing, constructing and connecting a carbon capture facility to a power plant or industry facility **will not be simple or easy** – likely to take 4 to 5 years or longer.
- **May not even be possible at all plants** and might require major changes at others
- There is **no one-size-fits-all** or one-design-fits-all for carbon capture facilities - not like going to Home Depot

No one should expect to see a new operating CCS retrofit or a new plant with CCS until 2028 or later – and we still won't know if it operates as projected for years after that

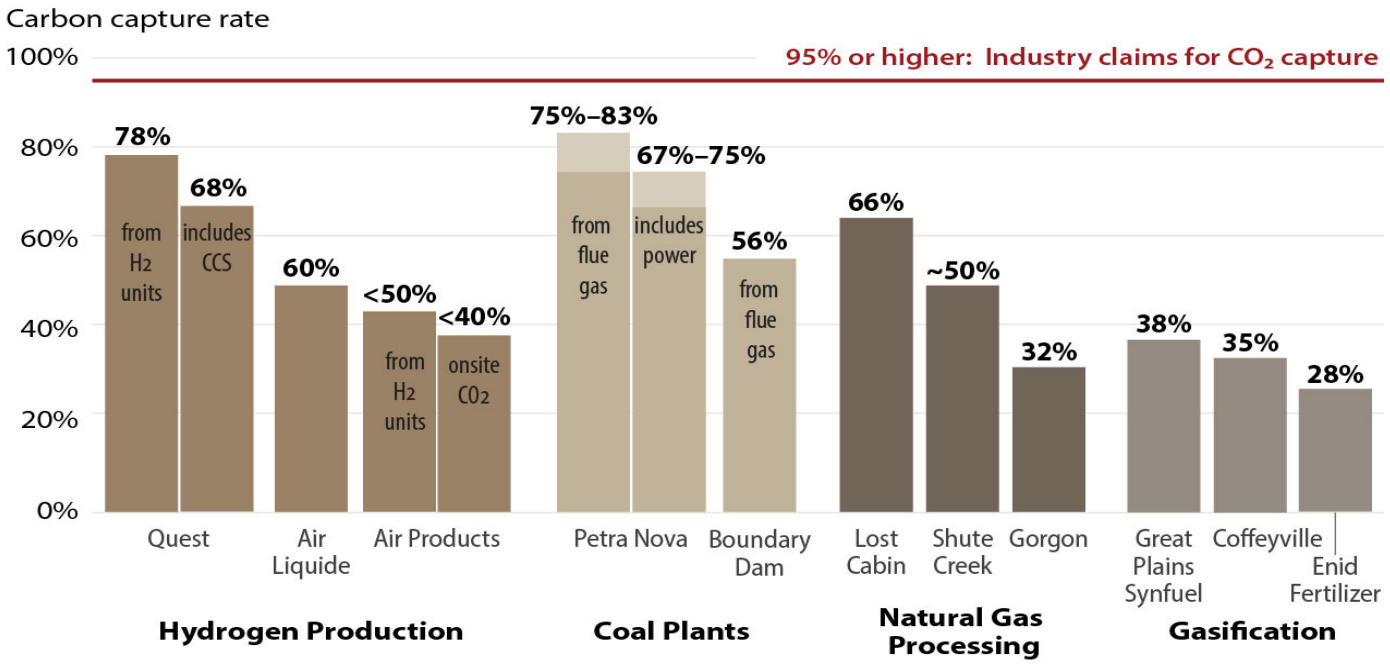
Can CCS Really be Relied Upon to Capture >95% of the CO2 Produced by a Power Plant, Hydrogen Production Facility or Other Industrial Project?

There is Only Very Limited Experience with Carbon Capture

CCS has been around for decades, but there are **only about 30 active carbon capture projects in the world**. Numerous projects had been cancelled or have failed.

- Coal-fired power plants: There are **only two** in the world capturing any of their CO_2
- Gas-fired power plants: **No CO_2 has been captured** at a commercial-size plant
- Steel plants: **CO_2 has been captured at one plant** in Dubai
- Concrete plants: **No plant** has captured any CO_2
- Hydrogen plants: **None of the 3 plants** that have captured CO_2 has captured more than 68% of the total it has produced

Real-World Experience Shows CCS Is not as Effective as Proponents Claim



Now That Governments Want to Hold Companies to Claims that High Capture Rates Are Feasible, They're Not So Sure

For example, the International CCS Knowledge Centre has hyped ≥90% CO_2 capture rates for years. But it backs off from that claim in comments on the proposed Canadian Clean Electricity Regulations:

> *To meet the proposed [emissions] limit, CCS facilities must achieve and **maintain a 95% CO_2 capture efficiency**, which may be attainable under steady-state conditions in the future but is **unlikely to be achievable** under normal or unforeseen operational fluctuations and based on current operational experience averaged over a year-long period.*

Source: Canada's Proposed Clean Electricity Regulations – Implications for CCUS, October 2023

Then On What Basis Do CCS Proponents Claim that ≥90% or >95% CO_2 Capture is Technically Feasible?

Small-scale technology testing

- The two ongoing "large" pilot-scale tests of new or enhanced CC technologies are targeting capture of **≤5% of the total CO_2** produced by two U.S. commercial-scale coal plants
- Testing that developers described as a "game changer" for gas-fired plants is designed to capture just **1% of the CO_2** produced by a large combined cycle plant in California

Unsupported claims by the proponents / developers of CCS projects that have not yet been built and operated, some of which are not yet funded or under construction

Small-scale testing is an important step but should not be relied upon to prove that full-size plants will achieve ≥95% CO_2 capture rates for decades

Scaling up new technologies has been shown to be more difficult than expected. Kemper power plant in Mississippi is a prime example.

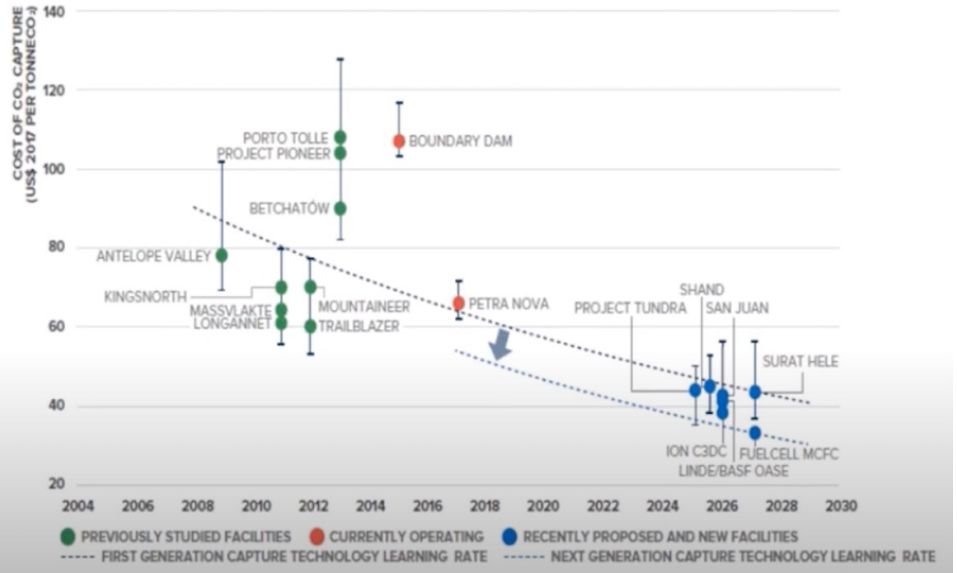
Will CCS be Financially Viable Without Massive and Permanent Government Subsidies?

EXXON already advocating to increase 45Q Subsidy

Proponents of CCS Claim Capture Costs Are Going Down

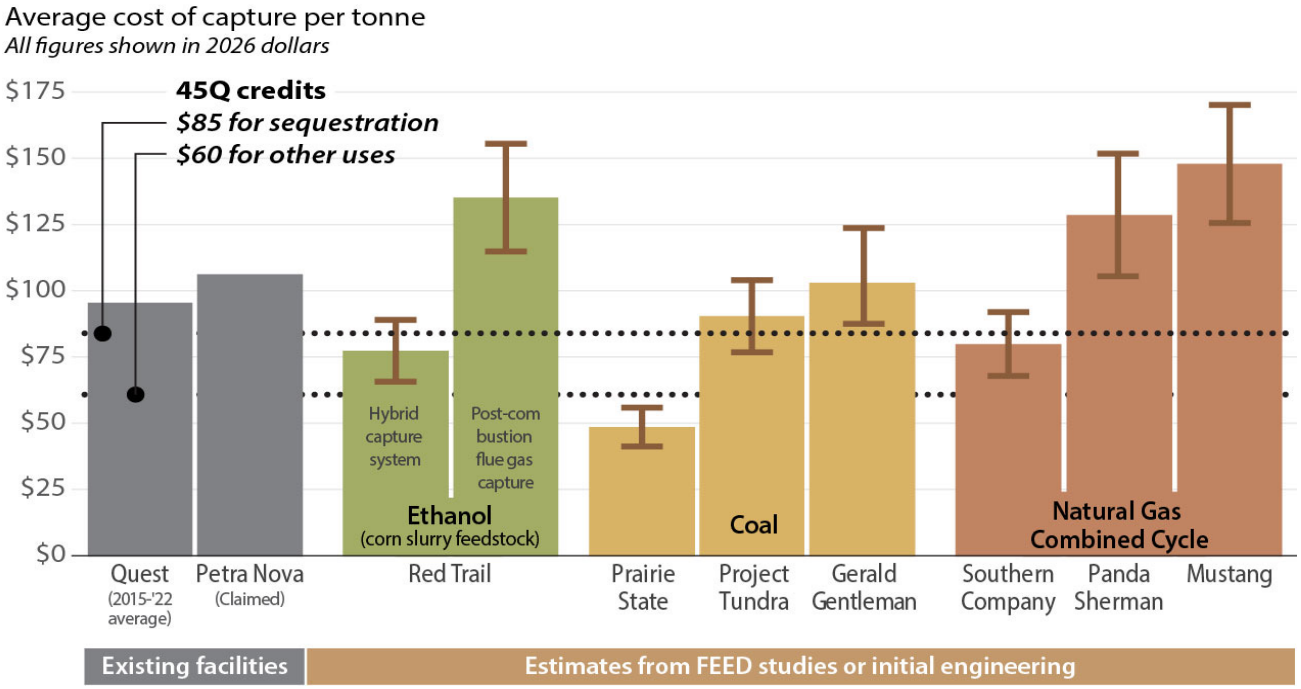
COST REDUCTION

- CCUS cost has reduced significantly
- Shand FEED study based projects cost of $45/tCO$_2$, down 57% from Boundary Dam
- Capital and variable operating and maintenance costs were the main levers
- Shand fits in a cluster of more recent projects at around $43-45/tCO$_2$
- Learning by doing could reduce this by further 50-75% by 2060



LCOE for coal power plant with post-combustion capture (Zapantis and others, 2019)

But Recent CO_2 Capture Cost Estimates Shown No Such Decline



Other Key Points to Keep in Mind About CO2 Capture Cost

- The estimated capital cost of retrofitting existing plants for CO_2 capture have increased dramatically as their engineering designs have become more detailed
- Yet designs are not yet fully complete
- Cost of transporting and sequestering captured CO_2 very uncertain

Can We Be Confident that Captured CO_2 Stored "Permanently" Underground Actually Will Stay There?

What Has Been Done to Date With the Captured CO_2?

- Some stored underground
- Some used for industrial purposes – e.g. carbonated beverages
- **~75% of captured CO_2 has been used for Enhanced Oil Recovery (EOR) to produce additional oil that might not otherwise be economical or technically possible to get**
  - On average each ton of CO_2 produces 2 to 4 barrels of oil
  - When burned, each of these barrels of oil might produce 0.44 tons of CO_2
  - As a result, EOR may mean no net reductions in CO_2 emissions – actually could mean higher CO_2 emissions
  - This is why using captured oil for EOR is a really bad idea.
  - Injecting captured CO_2 also produces earthquakes in some areas

Permanent Underground Storage of Captured CO_2 Is Not Guaranteed to Work as Planned

Two projects in Norway are presented as prime examples of how CCS works. But a recent IEEFA study showed even these projects **haven't worked as planned**:

- Despite extensive and expensive state-of-the-art modeling of underground geology, some of the **captured CO_2 has gone where no one expected it would go**
- Once injected, **not much can be done to manage CO_2 underground**

Are There Lower Cost Options for Decarbonizing the Economy than CCS?

YES!
COMPLETE ANALYSIS IS COMING

For More Information

- See recent IEEFA Reports
  - Blue Hydrogen: Not Clean, Not Low Carbon, Not a Solution
  - Norway's Sleipner and Snohvit CCS: Industry models or cautionary tales?
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