Institute for Energy Economics and Financial Analysis

Fact Sheet:

Carbon Capture for Steel

- **Steelmaking is highly carbon intensive, accounting for a quarter of industrial emissions and 7% of global CO_2 emissions, amounting to 2.6Gt/y.**
- **There is significant concern that steel produced using fossil fuel-based technologies retrofitted with carbon capture, utilisation and storage (CCUS) fails to meet green steel requirements.**
- **CCUS has a long history of failure and underperformance in other sectors.**

Diminishing prospects for CCUS in the steel sector

International Energy Agency (IEA)

Net Zero Roadmap Scenario by 2050

		2021 Forecast	2023 Forecast
CCUS ↓	Projected share of CCUS-equipped technologies in primary steelmaking by 2050	53%	37%
H2 ↑	Projected share of hydrogen-based technologies in primary steelmaking by 2050	29%	44%

> **“The history of CCUS has largely been one of underperformance.**

IEEFA expects that CCUS's role in steel decarbonisation will decrease further in future updates by the IEA.

Bloomberg New Energy Finance (BNEF)

CCUS Outlook 2023 report

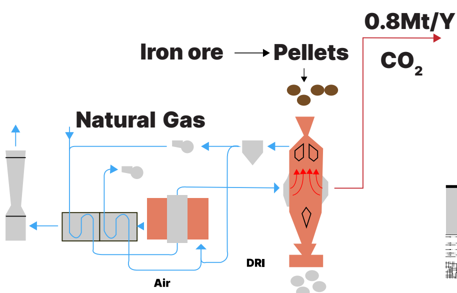
	Global Carbon Capture Capacity (Mt)	Iron and Steel Share (Projects)
2022	50	2%
2035	420	1%

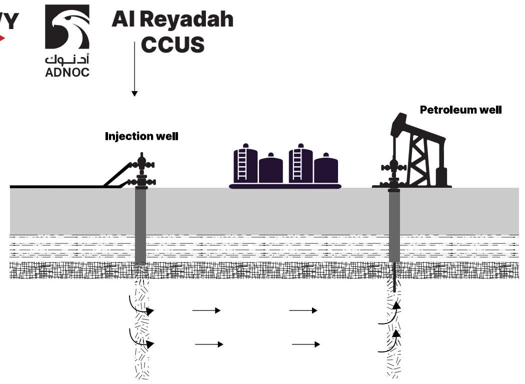
> **“CCUS capacity currently captures only 0.1% of global emissions.**

Even if all pipeline projects proceed, CCUS will only capture 1.1% of current global emissions in 2035 according to BNEF. Iron and steel projects make up only 1% of the pipeline.

Al Reyadah: The world's only commercial-scale CCUS plant in the steel sector

The CCUS plant, operational since 2016, possesses a CO_2 capturing capacity of 0.8Mtpa. This amounts to only 19-26% of the plants total Scope 1 and 2 emissions.





	2020	2021	2022
Rate of capture of total emissions (%)	19.3%	19.9%	26.0%

CO_2 injected into Bab and Mumaitha oil wells for Enhanced Oil Recovery

The increase in capture rate to 26% was not attributable to the enhanced performance of the CCUS facility, but rather to a reduction in total CO_2 emissions resulting from a greater proportion of clean electricity used in the mix. (Scope 2)

CCUS has a poor track record across various sectors

Project	Capacity ($MtCO_2$ p.a.)	Performance
Natural Gas processing		
1986 Shute Creek	7	Lifetime under-performance of 36%
1996 Sleipner	0.9	Performing close to the capture capacity
2004 In Salah	1.1	Failed after 7 years of operation
2007 Snøhvit	0.7	Performing close to the capture capacity
2019 Gorgon	4	Lifetime under-performance of ~50%
Industrial sector		
2000 Great Plains	3	Lifetime under-performance of 20–30%
2013 Coffeyville	0.9	No public data was found on the lifetime performance.
2015 Quest	1.1	Performing close to the capture capacity
2016 Abu Dhabi	0.8	No public data was found on the lifetime performance.
2017 Illinois Industrial (IL-CCS)	1	Lifetime under-performance of 45–50%
Power sector		
2014 Kemper	3	Failed to be started
2014 Boundary Dam	1	Lifetime under-performance of ~50%
2017 Petra Nova	1.4	Suspended after 4 years of operation

The Carbon Capture Crux- Lessons Learnt

Overpromising, Underperforming:

Even after 50 years of implementation, CCUS has failed to deliver its promised results in several sectors. CCUS is susceptible to significant financial, technological and environmental risks, compounded by uncertainty over the effectiveness of geological CO_2 storage.

No Cost Improvements, and No Scalability:

The uniqueness of each CCUS project limits technological learning and cost reductions, unlike more promising climate solutions such as renewables, batteries or electrolysers.

High Leakage Risk:

CCUS poses a significant risk of CO_2 leakage from transportation and storage. The permanency of CO_2 storage must be regularly checked through monitoring and field surveillance.

Specific challenges in the steel sector

Partial CO_2 removal

Achieving complete carbon neutrality via CCUS in the steel sector is challenging due to the multiple point sources and low concentration of CO_2 (particularly in BF processes), with high residual emissions.

Low CO_2 concentration leads to higher cost

The cost of carbon capture in the steel sector is notably higher compared to other sectors with high CO_2 concentrations, such as natural gas processing, ammonia, and ethanol.

Limited proximity to storage sites

Many existing steel mills are situated far from reliable geological storage facilities for captured CO_2.

Missing Scope Three emissions

CCUS does not address Scope Three emissions, particularly from coking coal mining with high methane emissions.

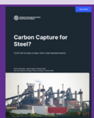
Limited CCUS implementation

Only one commercial-scale CCUS plant exists in the steel sector, which has been retrofitted to DRI facilities.

Counterpart solutions and technological advancements

Other promising technologies including DRI-EAF have already surpassed CCUS in steel decarbonisation efforts.

Download our report



Carbon Capture for Steel?
CCUS will not play a major trole in steel decarbonisation

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy.

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