Carbon Capture Utilisation Storage

LAVAUX

About LAVAUX

We are a leading strategy, operations consulting and organizational transformation firm.

At the heart of everything we do is our unrelenting drive to peek into and make sense of the future.

We are strategists, management consultants and advisors — inspired by transforming clients' businesses so that they can reach escape velocity.

Is Oil produced via CO2-EOR Cleaner ?

To have a chance of avoiding 1.5C or more of global heating, scientists have estimated that the world can only emit 420bn (*high confidence*) to 580bn more tonnes of greenhouses gases. This is commonly called, the "**available carbon budget**".

Staying within a remaining carbon budget of 580 $GtCO_2$ implies that CO_2 emissions reach carbon neutrality in about 30 years, reduced to 20 years for a 420 $GtCO_2$ remaining carbon budget. More recent work from IPCC WG1, places now this figure at 260 $GtCO_2$.

If emissions do not start declining in the next decade, the point of carbon neutrality would need to be reached at least two decades earlier to remain within the same carbon budget.

To date, the carbon emissions embedded in the fossil fuel reserves exceed 3,200Gt of CO_2, that is roughly eight times the available carbon budget.

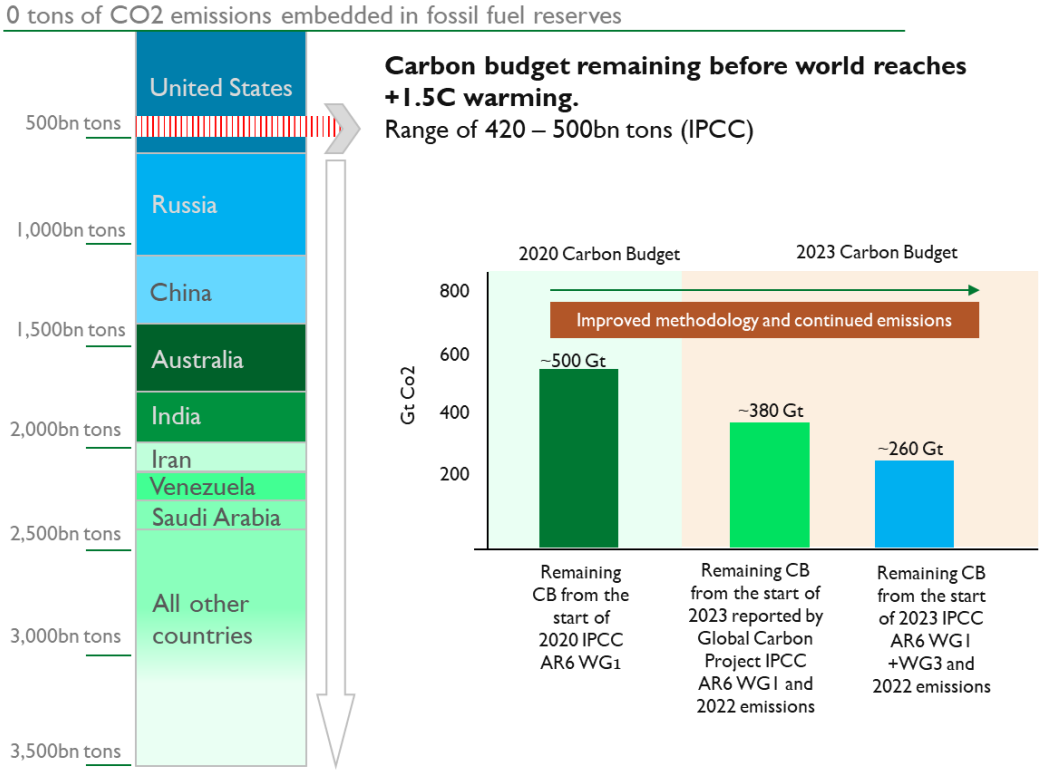

Fig. 1 Carbon budget to 2050 vs. CO2 emissions embedded in fossil fuel reserves

CCUS today.

One of the available pathways for emission reductions is by capturing carbon dioxide directly from point source emitters via carbon capture utilization and storage or directly from air (called direct air capture or DAC).

Today via CCUS, we capture around 49 Mtpa from 41 facilities with an additional 361Mtpa capacity in the project pipeline. The progress made on the CCUS front is fantastic with 198 new facilities added to the project pipeline since last GCCSI report in 2022. At the time of writing this briefing note, 312 CCUS facilities are in construction or under development, that is almost double the numbers last year.

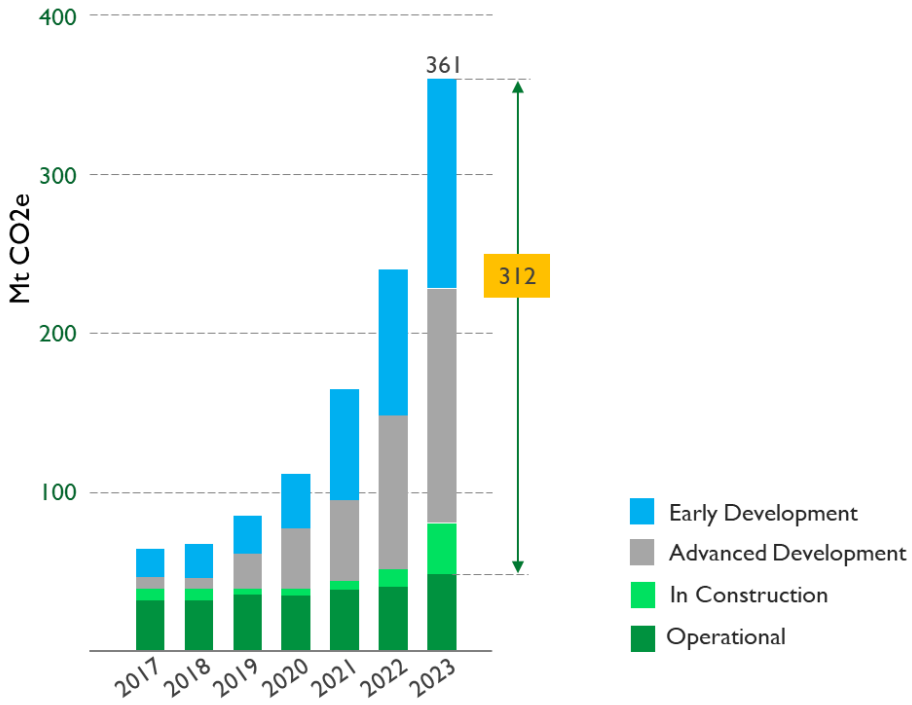

Fig. 2 Carbon capture capacity operational or in development as of Nov. 1, 2023

The "U" in CCUS

Some of the CO_2 captured via CCS is used in the process of oil recovery. Enhanced Oil Recovery (or EOR) is a process of artificially stimulating a reservoir to recover more oil after secondary recovery techniques have become unable to sustain desired production volumes. Additionally, EOR is usually employed when the oil left in the reservoir is trapped in hard-to-reach (low-permeability) sections with poor oil-water contact or irregular fault lines.

By using CO_2 in the EOR process, the *emissions balance* of oil production and CO_2 changes, resulting in a cleaner production of oil. In the media, these figures are quoted differently based on the political inclination of the quoting entity.

We provide below, an unbiased calculation based on a full lifecycle methodology including the impact of EOR-produced oil (of one barrel) on global markets.

How much cleaner?

In general, to recover 1 barrel of oil, about 0.27- 0.3 tonnes of CO_2 is injected and stored as part of CO_2-EOR process.

A typical barrel of crude oil contains 0.42-0.51 tonnes of releasable CO_2 (assuming that 3% of the produced and refined oil barrel remains as asphalt or coke). Therefore, EOR lowers the well-to-wheel emissions from a barrel of EOR-produced oil to 0.21 tonnes of CO2.

Lifecycle Methodology

EOR operations at the project level have higher process emissions than conventional oil production.

There is a 0.03 tonne increase in CO_2 emissions from processes such as separation and recycling of CO2. Therefore, the benefit of CO_2 injection drops from 0.3 tonnes/bbl to a net reduction of 0.27 tonnes/bbl, hence the well-to-wheel emissions go up from 0.21 to 0.24 tonnes of CO_2.

If all EOR-supplied oil displaced existing supply of conventional oil, then the net reduction in emissions would be all of 0.27 tonnes of CO2/barrel. However, the operation of global oil markets does not allow for this one-for-one displacement. When oil produced through CO2-EOR hits the global market, 84% of EOR-supplied oil displaces existing supply and satisfies existing oil demand.

The remaining 16% percent represents an increase in oil supply, *which lowers the price of oil and results in increased oil consumption*.

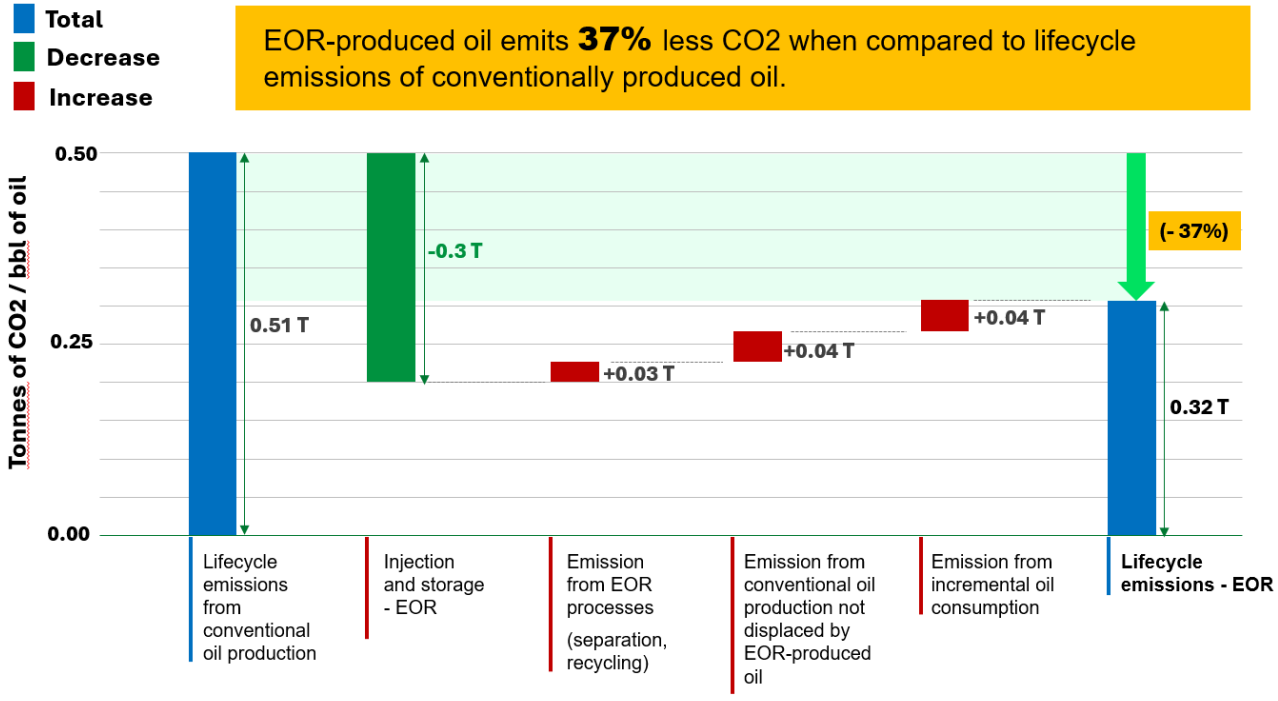

Fig. 3 EOR produced oil emits less when compared to the conventionally produced oil.

To account for market impacts, first, we calculate net reduction only to the extent there is displacement. To illustrate in Figure 3, we “add back” the unrealized net reduction from oil that is not displaced, i.e.16% of 0.27 tonnes or 0.04 tonnes of CO2.

Next, we “add back” emissions from the increase in oil consumption that *would not have occurred if not for the increase in oil supply from EOR,* i.e. 16% of 0.24 tonnes (well-to-wheel) emissions or 0.04 tonnes of CO2.

Conclusion

On a life cycle basis, every barrel of oil produced through CO2-EOR results in a net emission reduction of 0.19 tonnes of CO2 (or 37% less emissions).

In the media, we have seen optimistic figures as high as 70% (less emissions) to as low as 5%.

The methodology above shows that the benefits of EOR oil production using CO2 injection are indeed significant but perhaps not as high as often quoted by various sources.

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