ACR at WINROCK INTERNATIONAL

Performance Standard Supplemental Description

GREENHOUSE GAS EMISSIONS REDUCTION METHODOLOGY FOR CARBON CAPTURE AND STORAGE PROJECTS

VERSION 1.1

2023-10-03

Introduction

ACR's Methodology for the Quantification, Monitoring, Reporting, and Verification of Greenhouse Gas Emissions Reductions and Removal from Carbon Capture and Storage (CCS) Projects v1.1 (CCS methodology) enables the issuance of carbon credits to projects that capture, transport and inject anthropogenic CO2 during enhanced oil recovery (EOR) operations into an oil and gas reservoir located in the U.S. or Canada where it is permanently sequestered. The climate benefits of projects developed under this methodology are additional to what would have occurred under a business-as-usual scenario, current laws and regulations, and current industry practices, and without carbon market incentives. To demonstrate that the activities eligible under the CCS methodology are not common practice, ACR established a performance standard by evaluating adoption rates of capturing and storing anthropogenic CO2 emissions during EOR in the applicable industry sectors and geographies.

This supplemental description of the performance standard aligns with and complements the CCS methodology. It is intended to supply additional details to interested parties about the sources consulted and analysis performed during methodology development to support the performance standard established therein. ACR was inspired to publish this document to provide even more transparency on a core component of the methodology and principle of the ACR Program. Project Proponents and Validation and Verification Bodies do not need to consult this supplemental when performing the work of developing and validating/verifying projects under the methodology.

CCS Methodology Performance Standard

To qualify as additional under the CCS methodology, projects must exceed the performance standard defined in the methodology and pass a regulatory additionality test. The CCS methodology establishes a practice-based performance standard developed by evaluating the market adoption rates of CCS technology in the U.S. and Canada and concludes that, based on low penetration rates for such projects, any CCS project that meets the eligibility and other requirements of the methodology is additional.

Adoption Rates for Practice-Based Performance Standard

Table 2 of the CCS methodology shows the total number of industrial plants and industrial plants with operational CCS installed for capturing anthropogenic CO2 emissions (as of the September 2021 publication date). Only sectors that had operational carbon capture installed with CO2 actively being used for EOR were included; other sectors with eligible point source CO2 emissions or Direct Air Capture (DAC) were not included because there were no operational projects. The same table is presented below with an additional citation for ethylene oxide plants, a corrected value for ethanol plants, and a new adoption rate column.

Table 1: Industrial Plants in the US with CCS

ANTHROPOGENIC CO_2 EMISSION SOURCE	NO. OF PLANTS	NO. OF PLANTS CURRENTLY OPERATIONAL WITH CCS	ADOPTION RATE
Power Generation (Fossil Fuels)	3,297[2]	5	0.15%
Gas Processing Plants	510[3]	7	1.37%
Ethanol Plants	210[4]	4	2.38%

[1] Global CCS Institute, CO2RE Facilities Database, https://co2re.co/FacilityData (accessed November 1, 2020)

[2] Table 4.1 Count of Electric Power Industry Power Plants, by Sector, by Predominant Energy Sources within the Plant, 2009 to 2019, https://www.eia.gov/electricity/annual/html/epa_04_01.html

[3] US. Natural Gas processing plant capacity and throughput have increased in recent years, U.S. Energy Information Administration, March 7, 2019, https://www.eia.gov/todayinenergy/detail.php?id=38592

[4] Renewable Fuels Association, 2019 Ethanol Industry Outlook: Powered with Renewed Energy https://ethanolrfa.org/wp-content/uploads/2019/02/RFA2019Outlook.pdf

ANTHROPOGENIC CO_2 EMISSION SOURCE	NO. OF PLANTS	NO. OF PLANTS CURRENTLY OPERATIONAL WITH CCS	ADOPTION RATE
Hydrogen Plants (non-refinery)	146[5]	1	0.68%
Hydrogen Plants (refinery)	30[6]	3	10.00%
Ammonia Plants	97[7]	1	1.03%
Ethylene Oxide Plants	59[8]	1	1.69%
TOTAL	**4,349**	**22**	**0.53%**

Of the 23 U.S. plants with CCS, 14 are operating at commercial scale projects spread across large scale commercial and utilization facilities and nine are pilot or demonstration projects.[9]

The same table is presented below for CCS facilities in Canada. Only sectors that had operational carbon capture installed with CO2 actively being used for EOR were included; other sectors with eligible point source CO2 emissions or Direct Air Capture (DAC) were not included because there were no operational projects.

[5] Merchant Hydrogen Plant Capacities in North America, January 2016, https://h2tools.org/hyarc/hydrogen-data/merchant-hydrogen-plant-capacities-north-america

[6] U.S. Fertilizer production and mining facilities at a glance, CHS and The Fertilizer Institute, http://robslink.com/SAS/democd65/usproductionmaps.pdf

[7] Cement Plant locations in the United States https://www.cemnet.com/global-cement-report/country/united-states

[8] U.S. EPA Ethylene Oxide Commercial Sterilization Facilities. https://www.epa.gov/hazardous-air-pollutants-ethylene-oxide/ethylene-oxide-commercial-sterilization-facilities.

[9] Global CCS Institute, CO2RE Facilities Database. https://co2re.co/FacilityData (accessed November 1, 2020).

ANTHROPOGENIC CO2 EMISSION SOURCE	NO. OF PLANTS	NO. OF PLANTS WITH OPERATIONAL CCS [10]	ADOPTION RATE
Power Generation (Fossil Fuels)	100[11]	1	1%
Fertilizer Production	207[12]	1	0.48%
Hydrogen Plants	12[13]	1	8.3%
TOTAL	**319**	**3**	**0.9%**

As of publication of the methodology, the U.S. and Canada have favorable geologic conditions for CO_2 EOR and are working to establish permitting pathways for CCS projects.[14] However, the adoption rates for deployment of CCS technologies for industrial CO_2 emission sources are extremely low in both countries and determined to not be common practice.

In addition to the deployment of carbon capture infrastructure at industrial plants, CO_2 injection rates during EOR operations were also reviewed to evaluate adoption rates of anthropogenic CO_2 sequestration in the U.S. and Canada and globally. The International Energy Agency reports that in 2019, the global oil production was 100.6 million barrels/day.[15] By contrast, only 500,000 barrels/day were produced with CO_2 EOR, of which 30% of the CO_2 used was anthropogenic.[16] This represents 0.1% of global oil production. According to the U.S. Department of Energy, 5% of oil in the U.S. is

[10] Global CCS Institute. Global status of CCS 2021 (2021). https://www.globalccsinstitute.com/wp-content/uploads/2021/10/2021-Global-Status-of-CCS-Report_Global_CCS_Institute.pdf.

[11] World Resources Institute. Global Power Plant Database. https://datasets.wri.org/dataset/globalpowerplantdatabase.

[12] IBISWorld. Fertilizer Manufacturing in Canada - Number of Businesses. https://www.ibisworld.com/canada/number-of-businesses/fertilizer-manufacturing/480/.

[13] Hydrogen Analysis Resource Center, Merchant Hydrogen Plant Capacities in North America (January 2016). https://h2tools.org/hyarc/hydrogen-data/merchant-hydrogen-plant-capacities-north-america.

[14] Global CCS Institute, CO2RE Facilities Database. https://co2re.co/FacilityData.

[15] International Energy Agency. Oil Market Report - December 2020. https://www.iea.org/reports/oil-market-report-december-2020.

[16] International Energy Agency. Can CO_2-EOR really provide carbon-negative oil? (11 April 2019). https://www.iea.org/commentaries/can-co2-eor-really-provide-carbon-negative-oil.

produced through CO_2 EOR[17] of which 19% utilize CO_2 captured from industrial sources.[18] This represents less than 1% of U.S. total oil production. In Canada, approximately 1% of total production comes from CO_2 EOR, both anthropogenic and natural.[19,20] Despite a well-assessed potential storage capacity within EOR reservoirs of 2,367–21,200 GT in the U.S. and 198–671 GT in Canada,[21] anthropogenic CO_2 in hydrocarbon reservoirs during EOR is not common practice due to numerous factors, including high costs of capture and transportation and permitting uncertainty.

As a result of the analysis and findings described above, the CCS methodology concludes that, based on low adoption rates for CCS infrastructure and CO_2 injection for EOR, any CCS project that meets the eligibility and other requirements of the methodology is additional.

[17] U.S. Department of Energy, National Energy Technology Laboratory. 9.2. Commercial Carbon Dioxide Uses: Carbon Dioxide Enhanced Oil Recovery. https://netl.doe.gov/research/coal/energy-systems/gasification/gasifipedia/eor.

[18] Advanced Resources International, Inc. The U.S. CO_2 enhanced oil recovery survey (2021). https://adv-res.com/pdf/ARI-2021-EOY-2020-CO2-EOR-Survey-OCT-21-2021.pdf.

[19] Canada Energy Regulator. Canada's Energy Future Data Appendices, Crude Oil Production. https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.

[20] Alberta Economic Development Authority. EOR an opportunity for Alberta (2009). https://open.alberta.ca/dataset/d1cd3d1b-ec50-4c43-ab0c-32b0f2d780b5/resource/f58c2967-b2de-42fa-9c19-83975ed3b3d2/download/enhanced-oil-recovery-carbon-capture-storage.pdf.

[21] Consoli, C.P., Wildgust, N., Current status of global storage resources, 13th International Conference on Greenhouse Gas Control Technologies, GHGT-13, 14-18 November 2016, Lausanne, Switzerland. Energy Procedia 114 (2017) 4623-4628. https://www.globalccsinstitute.com/archive/hub/publications/201748/consoli-wildgust-2017-global-storage.pdf.