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Current status of enhanced oil recovery projects using carbon dioxide (EOR CO_2) in Croatia

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INTRODUCTION

The Global Status Report on Carbon Capture and Storage (CCS) [1] identifies 41 operational CCS facilities with a total CCS capacity of 49 million tonnes of CO_2 per year (Mtpa) in 2023. Additionally, 26 facilities are currently under construction with a total combined capacity of 32 Mtpa. CCS units are being used in the following industries: natural gas processing (34.3 Mtpa), chemical industry (10.7 Mtpa), power generation (1.7 Mtpa), oil refining (1.4 Mtpa), iron and steel production (0.9 Mtpa). The two carbon storage practices are EOR (37.8 Mtpa) and storage in dedicated geological formations (11.2 Mtpa).

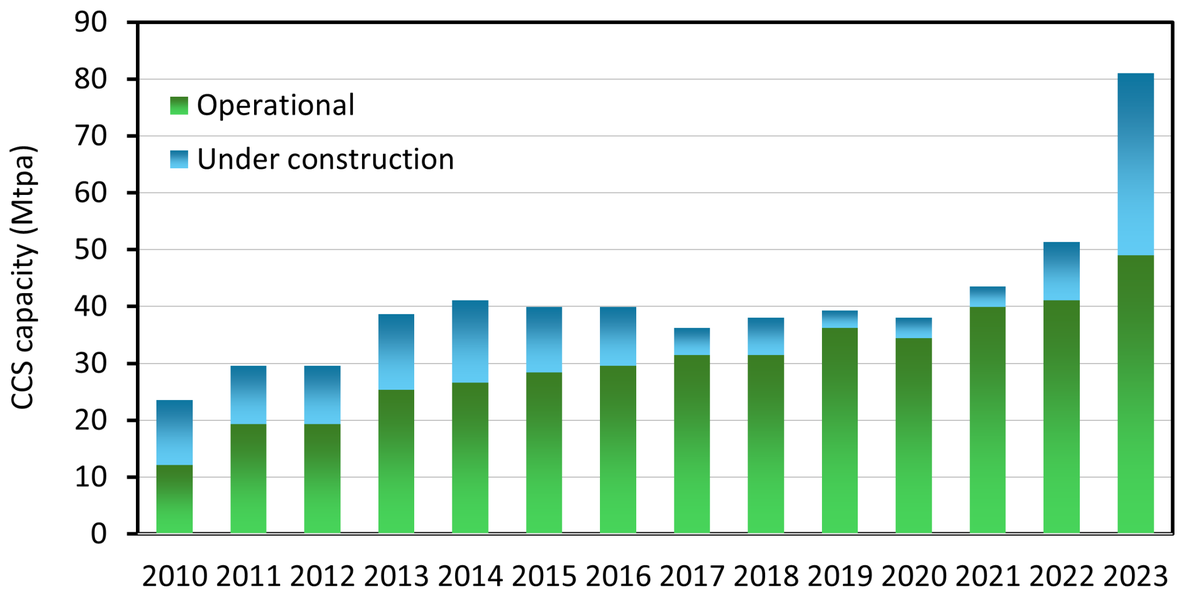

Figure 1. Total global capacity of CCS facilities between 2010 and 2023

CCS STATUS IN CROATIA

At present in Croatia there is one operational CCS project using CO_2 from a natural gas processing plant in Northern Croatia. The natural gas fields of Molve, Kalinovac, Stari Gradac and Gola contain high volume fractions of CO_2: from 9% in Stari Gradec up to 23.8% in Molve) and 53.6% in Gola. The wet sour gas in dehydrated and sweetened in the natural gas processing plant (NGPP) of Molve. The CO_2 stream is compressed to 30 bar and transported through a 88 km long pipeline to the compression and liquefaction unit (CLU Etan) at the location of the EOR fields. There, CO_2 is compressed to 90 bar, liquefied and pumped to 200 bar. The liquid CO_2 is distributed to WAG (water alternating gas) injection wells and pumped into the oil fields of Ivanić Grad and Žutica. Part of the injected CO_2 returns to the surface with the recovered oil and gas. CO_2 is once again dehydrated and separated from the gas stream. The process chart of the CO_2 EOR project in Northern Croatia is shown in figure 2.

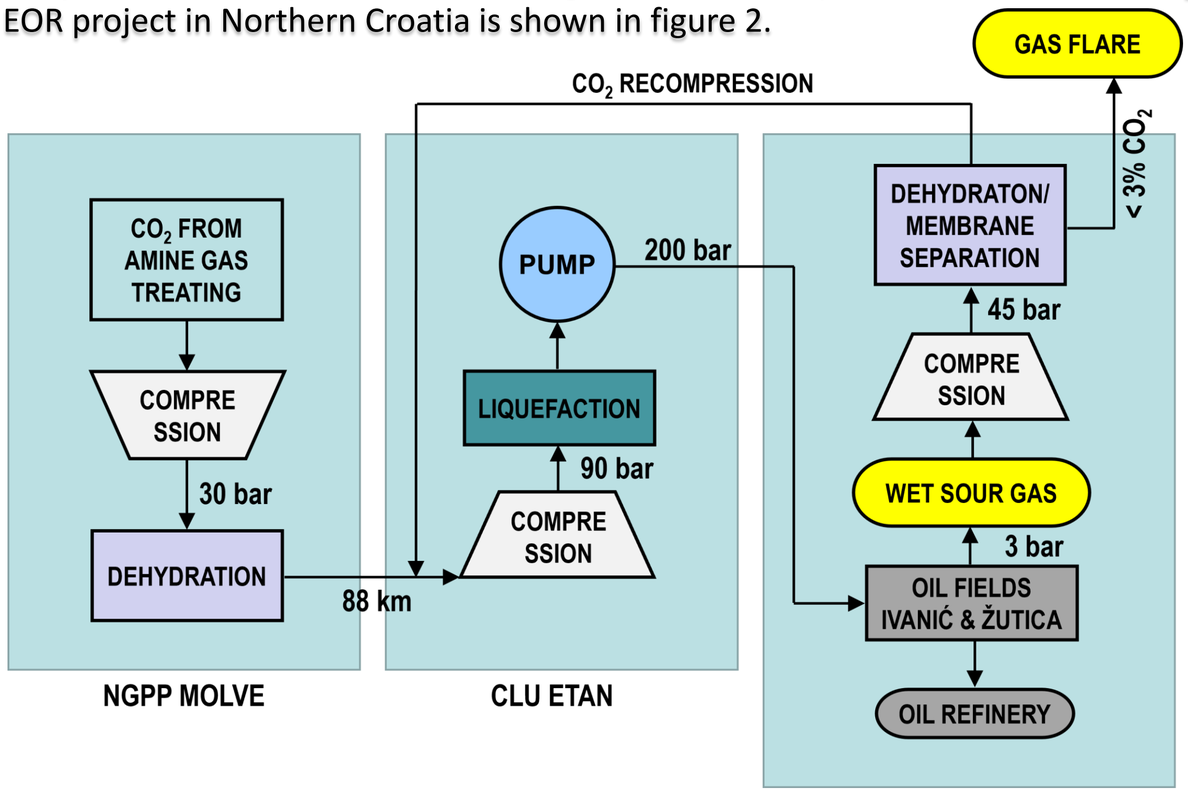

Figure 2. The CO_2 EOR project in Northern Croatia

RESULTS & DISCUSSION

The CO2 EOR project in Northern Croatia is aimed at increasing oil recovery from depleted oil fields. The CO_2 sequestration capacity of the project is 600.000 m^3/day, equivalent to 0.4 Mtpa. During the expected project lifetime of 25 years, 7 Mt of CO_2 will be injected into the oil field, out of which 5.4 Mt will be permanently stored and the remaining 1.6 Mt will resurface with the produced oil and gas. Primary oil recovery started in the 1960s and lasted for 10 years. Subsequently, secondary recovery took place in the 1970s and lasted for the next 40 years until 2015 when tertiary recovery was started. The oil recovery factor of the primary stage was only 9% and the secondary stage was able to increase it to around 35%. The CO_2 EOR project is expected to further increase the recovery factor to around 50%. By 2020, production rates at the Ivanić fields quadrupled relatively to the production prior to EOR, Figure 3.

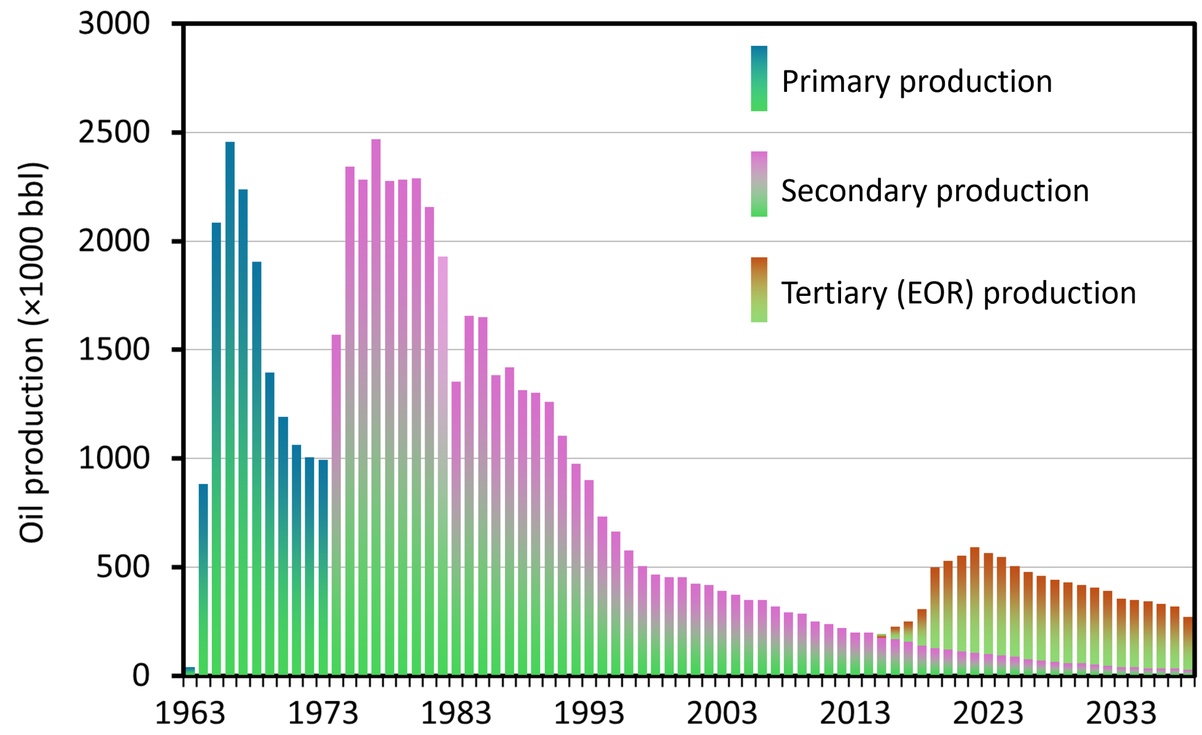

Figure 3. Timeline of oil production rates at the Ivanić oil fields

CONCLUSIONS / REFERENCES

New CCS facilities are expected to enter operation by 2030 In Croatia, with a combined capacity of 1.3 Mtpa of CO_2. Two CCS projects involve cement plants. The CO2NTESSA project will capture 0.7 Mtpa of CO_2 at the cement plant in Našice after upgrade with oxyfuel technology, and the CO_2 will be stored into a deep saline aquifer. The KOdeCO project will capture 0.367 Mtpa of CO_2 from the cement plant in Koromačno and will store it in an offshore geological formation. The fertilizer factory of Petrokemija Kutina will upgrade the ammonia production unit with CCS technology. This project will capture 0.19 Mtpa of CO_2 and use it at the EOR facility in Ivanić Grad [3]. Another project will capture 0.055 Mtpa from a bioethanol production plant and store it in depleted oil and gas fields [4]. The CCGeo project at Draškovec will generate power and heat from geothermal brine and natural gas dissolved in the water. The CO_2 will be separated from the exhaust gases and reinjected into the geothermal reservoir.

[1] Global CCS Institute: The Global Status Report of CCS 2023, Melbourne, Australia. URL: https://status23.globalccsinstitute.com/ (Accessed: May 2, 2024)
[2] The Int. Assoc. Of Oil and Gas Producers Europe: Map of CO_2 Storage Projects in Europe, URL: https://iogpeurope.org/resource/map-of-eu-ccus-projects/
[3] B. Saftić et al.: Study on new pilot and demonstration project opportunities for CO_2 geological storage onshore, 2020. URL: http://www.enos-project.eu/
[4] J. Lask et al.: Lignocellulosic ethanol production combined with CCS: A study of GHG reductions and potential environmental trade-offs, GCB Bioenergy 2021, 13, 336-347. https://doi.org/10.1111/gcbb.12781