Storage under pressure: How geological atlases contribute to and facilitate emissions management.

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SUMMARY

Models suggest that continued and sustainable fossil fuel requires that the average carbon intensity of energy sources, including fossil fuels needs to be or fall below 5 MtC/PWh (18.33 $MtCO_2$/PWh), which requires that carbon intensity decrease by 4–5 MtC/PWh per decade (14.67 - 18.33 $MtCO_2$/PWh per decade; DePaolo, 2015). Ultimately this will shift the source of much power to nuclear and renewable sources augmented by carbon capture and storage-aided use of fossil fuels, particularly during the transition, which may last into the next century. Carbon (dioxide) capture, utilization and storage (CCUS) provides a demonstrated but still developing technology that can contribute globally to the reduction of atmospheric greenhouse gas emissions. Policy models often suggest multiple pathways are required to achieve what is now commonly described as the global “net-zero” emissions goal. Among the variety of actions to reduce greenhouse gas emission, carbon capture storage and utilization typically is assigned the role of achieving between about a tenth to a fifth of the reduction with a similar range of emission reduction being assigned typically to fuel switching, generally by replacing coal by natural gas in many combustion applications, particularly stationary power.

Some of the earliest, and still some of the most effective, demonstrations of CCUS technology were performed in Canada, where unfortunately, there have been few major new initiatives and projects that actually put CO_2 into the ground. The recent flurry of activity to secure and develop CCS storage hubs masks the reality that there is no need to use or to store if there is no captured CO_2 to either use or store. In addition, there has been much criticism of the suite of CCUS technologies, both associated with performance challenges at some CCS projects, and due to perceptions and policies, perhaps ill-founded on the assumption that CCUS is simply a ploy to prolong the use of fossil fuels, and with that their associated emissions. This need not be the case, as this talk will address for a variety of applications including, enhanced petroleum recovery, the manufacture of decarbonized combustion fuels such as “blue” H_2, and the opportunities to move beyond emissions reductions into “net-negative” emissions, often employing direct air capture technologies. Currently about one third of all CO_2 use is for enhanced petroleum recovery, which is performed almost entirely in North America. MacDowell et al (2017) indicated that enhanced petroleum recovery coupled with pore space geological storage provide the largest capacity and most economical approach to managing captured CO_2.

Alberta is already the largest producer of hydrogen in Canada, much of it for ammonia manufacturing and bitumen upgrading. The Shell Quest Project, the world's best performing onshore CCS project, is essentially a model for future "Blue" Hydrogen production. Considering that one third of natural gas produced in Alberta is consumed by the province's bitumen industry the opportunity to decarbonize that source of current and future emissions indicates a potential importance of CCUS to industrial value chains cannot be underestimated. Pursued aggressively, it is possible that an active WCSB CCUS industry could be a source of investment, industry and employment that would rival the current WCSB natural gas industry.

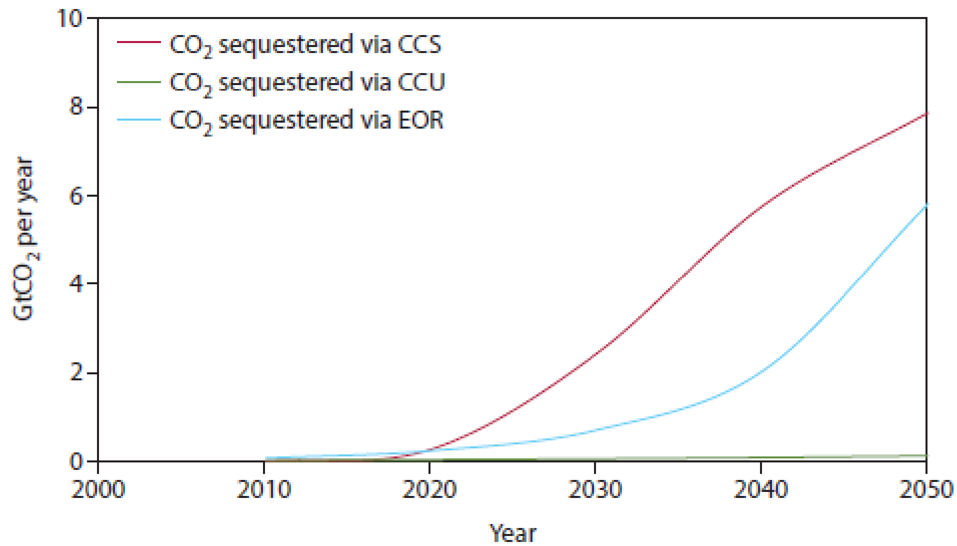

Figure 1: Potential future global contributions of pore space storage (red), enhanced oil recovery (blue) and all other sources of CO2 utilization (green – barely visible above the baseline) (From MacDowell et al., 2017)

Geological atlases are important sources of compiled and, hopefully, synthesized data and interpretation that typically provide important entry points to data and knowledge. The two completed WCSB Geological Atlases were each successful in their day. This included acting as models for the Carbon Sequestration Atlases, early additions of which addressed CCS in the United States and Canada, the latest edition of which addresses North American CCS opportunities (https://www.netl.doe.gov/coal/carbon-storage/strategic-program-support/natcarb-atlas). There is no requirement for the next addition of the WCSB Atlas to reproduce the existing resources, but there are several ways in which the new WCSB Atlas could supplement the existing storage Atlas.

The existing carbon storage atlas does not include or address important linkages among different resources that could enable the growth of the WCSB CCUS industry. A grocery list of these opportunities will be presented, such as the dependence of Direct Air Capture opportunities on available and suitable water resources. The WCSB also has some novel CCS opportunities including the storage of CO_2 as a gas hydrate in terrestrial settings, and the potential to perhaps double the conventional crude oil production life span of the WCSB through commercial EOR developments (Osadetz and Chen, 2007; Bachu, 2016; Hares, 2020).

CO_2-EOR is attractive because it provides income opportunities associated with CO_2 utilization and storage. Future projects would benefit from the adoption of existing recommendations for changes in policy and regulations (Gunter and Longworth, 2013). Note that the most successful CO_2 EOR projects have be primarily performed in reservoirs with stratiform porosity, such as Joffre Viking and Weyburn Midale, or small undifferentiated reefs (Alberta Energy Regulator, 2011; 2012). This activity would be worthwhile, as it holds the possibility for "net carbon negative oil (NCNO) production (Nunez et al., 2019). Acknowledging the potential for a linkage between CCS associated with H_2 production and the potential demand for large scale geological storage of H_2 produced in Alberta the atlas could also provide information and insights regarding the possible geological storage of "blue" H_2 in the WCSB. The recognition and inclusion of these linkages to other stratigraphic and thematic WCSB Atlas Chapters will assist with and improve the efficiency of the nascent WCSB CCUS industry.

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