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CO_2 injection well build-out scenarios for achieving 2DS

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Abstract

CCS is now considered critical for meeting the 2-degree Celsius scenario (2DS) goals, and expectations for the role of CCS in reducing atmospheric emissions from industrial energy use have been expressed by the International Energy Agency. To be effective in meeting 2050 goals, CCS must be deployed widely and rapidly. While it is easy to quantify the target CO_2 emissions reductions for CCS of 6-7,000 Mt per year by 2050, the logistical pathway for doing this is harder to envision. Recent publications suggest that neither storage capacity (Ringrose and Meckel, 2019) nor risk (Alcalde et al., 2018) are likely to limit development.

This study assumes that the target mass of CO_2 can be captured and delivered to injection wells at acceptable costs, largely ignoring the primary economic factors needed to ensure successful full-scale capture deployment. The analysis presented uses the historical development of hydrocarbon extraction wells drilled in various regions as a basis for the expected rate of future well deployment for CO_2 injection (Fig. 1). The most aggressive of these is the Bakken unconventional development in the central U.S., and the smallest scale is represented by the offshore hydrocarbon development offshore Texas. The Norwegian North Sea and the entire Gulf of Mexico represent other potential scenarios. This future hypothetical CO_2 well development assumes that experience and technology will allow a similar exponential growth in deployment as was observed for hydrocarbon extraction, as well as for other technologies (Kramer and Haigh, 2009). By making some further assumptions based on industry experience about the likely life of each injection well (25 years) and the average annual rate of CO_2 injection (0.7 Mtpa; Ringrose and Meckel, 2019), the future incremental and cumulative volume (Fig. 2) of injected CO_2 can be estimated. Such estimates are useful for understanding the scale of regional and global deployment needed, as well as for providing a basis with which to evaluate incremental progress and maintain targets.

This analysis focuses on the needed well development in the next ten years (2020-2030) to make the initial commitment needed to further enable the global deployment of offshore storage for facilitating 2DS by 2050. The results indicate that approximately 580 wells are needed globally by 2030 to stay on track for meeting goals in 2050 (Figure 1). Given that today there are globally on the order of tens of CO_2 injection wells dedicated to injecting industrial emissions (not including enhanced oil recovery), for a total of approximately 36 Mt in 2019 (GCCSI), an order of magnitude scale up is obviously needed over the next ten years. Given the expected exponential growth seen

for many technologies, each year that this well development pathway is delayed results in a dramatic and quantifiable shortfall in reaching the 2050 goals. For example, a 5-year delay in the implementation presented here (comparing 2025 numbers to 2030) could result in an approximately 80% reduction in the number of wells deployed and mass stored in 2030. This delay further projects to an approximately 50% underachievement in the cumulative CO_2 injected by the year 2050. These results emphasize the critical importance of continued rapid deployment of CO_2 injection wells, and provides nations a benchmark for understanding their progress using CCS toward goals of 2DS.

Keywords: CCS; offshore, wells, 2DS

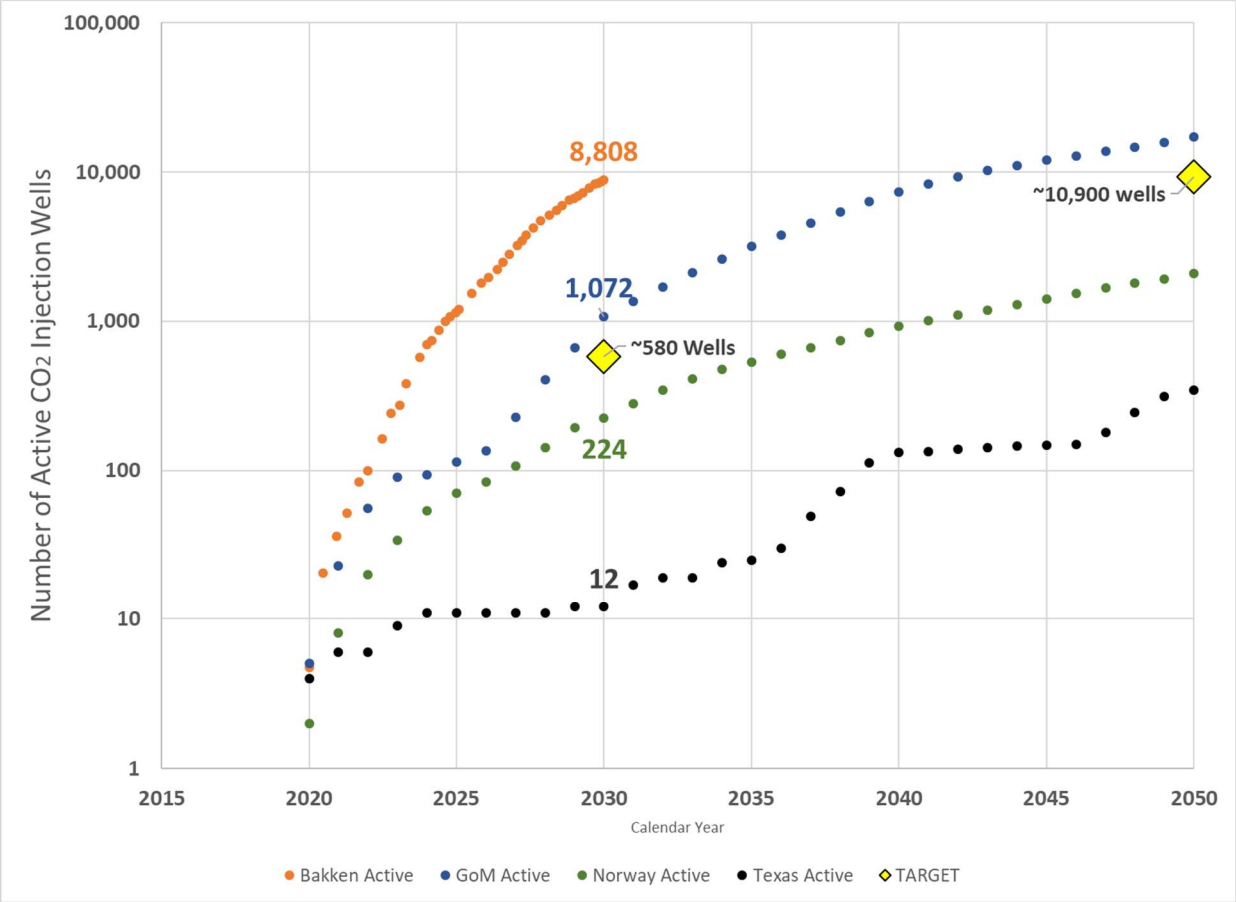

Figure 1: Projected future CO_2 injection well scenarios based on historical well development for four regions – The Bakken unconventional play in the onshore U.S. (orange; 2005-2015), the Gulf of Mexico (blue; 1947-2018), The Norwegian North Sea (green; 1966-2018), and the Texas ofshore (black; 1938-2010). Target values are estimated with yellow diamond symbols,based on the IEA 2050 goal of 6-7 Gtpa and the exponential character of the curves presented.

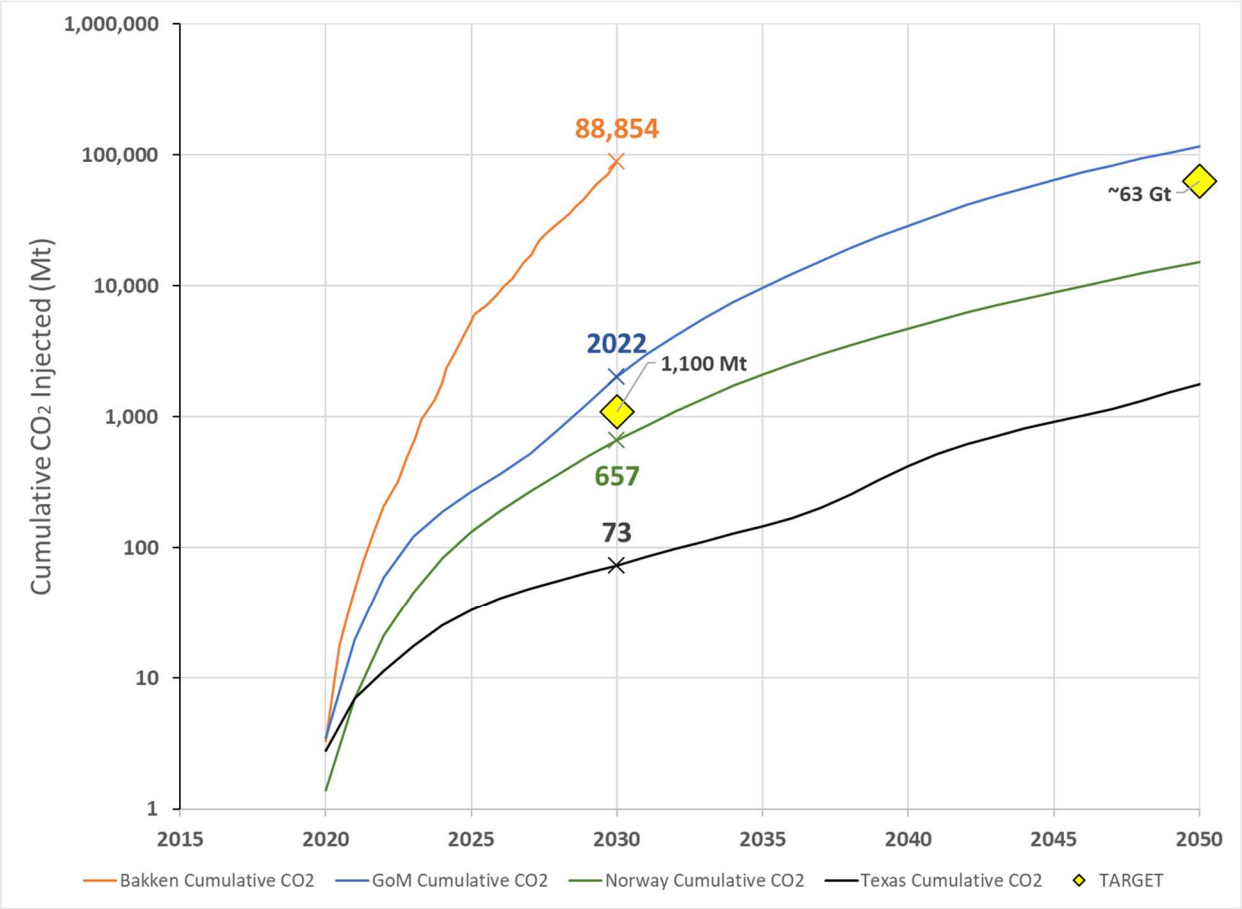

Figure 2: The hypothetical cumulative amount of injected CO_2 mass (in Mt) from the well development scenarios shown in Fig. 1. Targets related to 2DS scenario are estimated in the yellow triangles. Over 1 Gt CO_2 needs to be injected in the next ten years to maintain the trajectory needed for achieving 2DS targets.

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