CO_2 CAPTURE FROM THE INDUSTRY SECTOR

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It is widely accepted that greenhouse gas emissions, especially CO_2, must be significantly reduced to prevent catastrophic global warming. Carbon capture and reliable storage (CCS) is one path towards controlling emissions, and serves as a key component to climate change mitigation and will serve as a bridge between the fossil fuel energy of today and the renewable energy of tomorrow. Although fossil-fueled power plants emit the vast majority of stationary CO_2, there are many industries that emit purer streams of CO_2, which result in reduced cost for separation. Moreover, many industries outside of electricity generation do not have ready alternatives for becoming low-carbon and CCS may be their only option. The thermodynamic minimum work for separation was calculated for a variety of CO_2 emissions streams from various industries, followed by a Sherwood analysis of capture cost. The Sherwood plot correlates the relationship between concentrations of a target substance with the cost to separate it from the remaining components. As the target concentration increases, the cost to separate decreases on a molar basis. Further, a spatial analysis of CO_2 point sources revealed that as the purity of CO_2 emissions increases, the quantity at a single source tends to decrease. Furthermore, the lowest cost opportunities for deploying first-of-a-kind CCS technology were found to be in the Midwest and along the Gulf Coast. Many high purity industries, such as ethanol production, ammonia production and natural gas processing, are located in these regions. The southern Midwest and Gulf Coast are also co-located with potential geologic sequestration sites and enhanced oil recovery opportunities. As a starting point, these sites may provide the demonstration and knowledge necessary for reducing carbon capture technology costs across all industries, therefore improving the economic viability for CCS and climate change mitigation. The various industries considered in this review were examined from a dilution and impact perspective to determine the best path forward in terms of prioritizing for carbon capture. A possible implementation pathway is presented that initially focuses on CO_2 capture from ethanol production, followed by the cement industry, ammonia, and then natural gas processing and ethylene oxide production. While natural gas processing and ethylene oxide production produce high purity streams, they only account for relatively small portions of industrial process CO_2. Finally, petroleum refineries account for almost a fifth of industrial process CO_2, but are comprised of numerous low-purity CO_2 streams. These qualities make the latter three industries less attractive for initial carbon capture implementation, and better suited for consideration towards the end of the industrial carbon capture pathway.