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The Impact of a H_2 Economy on Stratospheric Ozone Loss

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Although the use of pure hydrogen (H_2) in fuel cells produces only local emissions of water vapour as exhaust gas the impact of direct H_2 emission to the atmosphere from pipeline leakages could be a source for increased stratospheric water vapour (H_2O) levels. Stratospheric H_2O is beside other factors the basis for the conversion of men made chlorofluorocarbons into active chlorine compounds in the polar regions. The chemical reactions between these species and ozone lead to a massive destruction of the earth-protecting ozone layer. To estimate the contribution of a H_2 economy to a stratospheric H_2O increase and the risk involved for an additional polar ozone depletion, we investigated four different H_2 scenarios. Our analysis were based on box model investigations that determine the average H_2O increase in the Arctic stratosphere caused by a atmospheric H_2 increase. Based on these results we calculated the impact on the formation of active chlorine (ACl) by using operational analysis of the European Centre for Medium-Range Weather Forecasts for the period 1984 to 2005. The corresponding ozone depletion was determined from an empirical relation between the average ACl volume and the ozone column loss. With this method we were able to provide estimates of the ozone loss that a future H_2 economy could cause. The results show that for high leakage rate assumptions additional ozone column losses of approximately 9% could be achieved whereas more moderate H_2 emission scenarios indicate additional losses below 3%.