Techno-economic analysis of four concepts for thermal decomposition of methane: Reduction of CO$_2$ emissions in natural gas combustion

This paper presents a techno-economic analysis of four concepts that apply the thermal decomposition of methane (TDM) with the aim of reducing carbon dioxide emissions in natural gas combustion. Different technical solutions are applied to convert methane in natural gas to gaseous hydrogen, which is combusted to produce electricity with a steam power cycle, and solid carbon, which is assumed to be sold as carbon black. The cost of electricity production and the potential to reduce CO$_2$ emissions in each concept were evaluated and compared to the reference case of direct methane combustion. With a moderate emission allowance price (20 €/tCO$_2$) and product carbon price (500 €/tcarbon) the cost of electricity production in the concepts was 12–58% higher than in the reference case. However, the price of product carbon had a significant effect on the feasibility of the concepts. Thus, the methane burner, which showed the best performance, produced 17% less CO$_2$ emissions per MWh$_e$ and had a smaller cost of electricity production than the reference case already with the carbon price of 600–700 €/tcarbon.

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