Jaap Vente - Abstract

How to overcome thermodynamic limitations in carbon utilization

Within 50 years, the energy system will have changed dramatically from today. Currently, the great majority of energy used originates from fossil sources. Only a relatively small part comes from renewable sources. In the future, we will experience an energy management system that is dominated by intermittent renewable electricity generation. However, even then the assumption is that the economy is still carbon based. Further, liquid carbonous fuels will remain dominating the shipping, long haul trucking and air transportation markets for a long time to come. The consequences of these developments are that the power and the refinery sector will change dramatically. On the other hand, energy intensive and main CO_2 emitting industries, like steel and cement sectors will continue to produce CO_2 because of lack of alternatives.

The chemical use of CO_2 can play a significant role in the overall energy management system. Renewable hydrogen is used to react with the CO_2 and form fuels and chemicals. In this overall picture, the role of carbon monoxide is too often neglected, whereas it can play a valuable role in this system.

A major limitation in the conversion step from CO/CO_2 and H_2 to fuels and chemicals, is the thermodynamic equilibrium. Specific examples that suffer from this limitation include methanol, dimethyl ether and dimethyl carbonate.

This presentation will focus on a number of current activities of ECN, including various piloting activities in the steel industry for CO_2 capture and methanol production, as well as the synthesis of dimethyl ether based on CO_2 rich feed streams.