Methanol as a Motor Fuel - Review

Participants

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- Deutsches Biomasseforschungszentrum (Germany)
- Fachagentur Nachwachsende Rohstoffe (Germany)
- Lund University (Sweden)
- Swedish Transport Administration (Sweden)
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Policy Relevance

Methanol could become a cost efficient, clean and green alternative for replacing fossil fuel in road transport and shipping sectors, if relevant supporting measures and instruments are introduced.

Major Conclusion

Methanol as motor fuel was demonstrated in large vehicle fleet during the 1980/90s. Despite technical success methanol was not a commercial success. Recently, **there is again an increasing interest on methanol as fuel.** Prominent examples are China as largest user of methanol as automotive fuel and Europe where methanol is being considered as marine fuel or to be used in fuel cell electric vehicles. Internal combustion **engines using methanol as fuel could be** further **developed for high efficiency to gain maximum energy and pollutant savings.** However, if methanol will be applied as automotive fuel with higher blending rates or as pure fuel technical adjustments of the existing fuel infrastructure are required (e.g. modifications of some fuel-carrying materials, safety measures).

Background

Global warming is a major threat for continuation of humankind as we know it today, and concerted actions are needed in all economic sectors to reduce GHG emissions. Especially in the transport sector, improving energy efficiency of engines is not enough, and thus fossil-free fuels are required to alleviate climate burden. The **most effective fuels are** those **with minimum GHG emissions and minimum pollutants along the well-to-wheel (WTW) chain,** while **compatible with** common internal combustion **engines and fuel infrastructure.**

There are many alternative fuel options (e.g. methane, methanol and other hydrocarbons as well as hydrogen) using different resources and conversion technologies. If focusing on methanol, suitable resources can be fossil (e.g. natural gas, coal), biogenic (e.g. lignocellulosic), waste streams (e.g. municipal waste, plastics) or renewable hydrogen and circular CO_2. **The greenhouse gas saving potential of** renewable **methanol could be** quite **high.** To achieve this goal the operational **renewable production capacities have to be increased** massively to get a perceptible impact of substituting fossil energy carrier in the future. Providing renewable fuels for engines does not renounce the need for adaptation of advanced technologies, such as electric powertrains.

Research Protocol

The IEA-AMF TCP Annex 56 Methanol as Motor Fuel covers inputs from several projects in participating countries Finland, Denmark, Sweden and Germany. Operating agents are Gideon Goldwine (Israel), Päivi Aakko-Saksa (Finland) and Wibke Baumgarten (Germany). In this annex, various aspects of *Methanol as Motor Fuel* are reviewed and evaluated: from its production to its application in engines, including advantages and disadvantages. Barriers and an outlook on the potential and possibilities of methanol as motor fuel are given.

Focus topics were as follows:

- General issues on methanol (e.g. conversion technologies, GHG emissions, costs, safety and handling).
- Methanol as motor fuel in marine, heavy-duty and light-duty engines.
- High-efficiency methanol engine concepts.
- Barriers for commercialization.

The summary report and the Appendices of IEA-Advanced Motor Fuels TCP Annex 56 are available at **http://iea-amf.org**. Therein, the financial support from several organisations are acknowledged; the preparation of the Annex 56 summary report has been sponsored by the Methanol Institute (MI), USA.

Key Findings

Key findings from the report are summarized as follows:

- **Methanol is a multipurpose fuel** as it could be used straight or as blending component in fuels, for the production of fuel additives or for fuel cell application.
- **Several concepts for internal combustion engines are available for using methanol** in passenger cars, light-duty and heavy-duty engines as well as in ships.
- **Straight methanol burns with very low particle and NO_X emissions** in refitted engines. A further reduction of pollutants could be expected for future high efficiency combustion engines.
- **Methanol could significantly increase the engine efficiency in dedicated engines.** Therefore additional research and development is needed to realize this potential – also from an OEM perspective.
- The existing fuel infrastructure requires no adjustments for low level methanol blends. **For higher methanol blends and straight methanol, the adjustments of the existing fuel infrastructure are well known.** There are considerations needed regarding material compatibility and safety handling.
- **In order to support GHG mitigation in transport, production capacity of sustainable renewable methanol has to increase** from the current level of less than 1 million tonnes per year to cover a part of the transport sector. Today methanol is mainly produced from fossil resources at the global production capacity of about 125 million tonnes.
- **Production costs and GHG reduction potentials of renewable methanol** produced on an industrial scale **can be competitive** to established renewable fuels, if using suitable resources like waste wood and cultivated wood.
- **Supporting elements on strategic, regulatory, technical and communicative level** are of overarching importance like for any alternative fuel in transport.