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Powerfuels in Industry: Process Heat

Powerfuels will have to play an important role for decarbonizing industrial heat. This particularly holds true for processes where no efficient electro-thermal alternatives exist.

Industrial heat accounts for almost one-fifth of global energy consumption and two-thirds of industrial energy demand. Since the vast majority of industrial heat originates from fossil-fuel combustion, it constitutes around 30 per cent of the industrial and 12 per cent of the total global CO_2 emissions[1].

Improving energy efficiency is crucial to reduce the overall energy demand for industrial heat, therewith directly avoiding greenhouse gas (GHG) emissions. For the production of low and medium temperature heat, direct use of renewable energies like solar or geo thermal, as well as the use or renewable electricity with heat pumps or electrode boilers are able to further reduce GHG emissions. For high temperature heat applications, biofuels are the currently most-used renewable option. However, since biofuels on a global scale have a limited volume potential[2], powerfuels are essential to reach climate goals while fulfilling energy demands in application areas like high process heat as well as for example air and sea transport.

Powerfuels offer a sustainable alternative to these challenges. They can be chemically identical to currently used fuels, thus replacing fossil resources in existing processes, infrastructures and technical devices to produce high temperature heat.

20 % of global energy is consumed for industrial heat[1]

12 % of global greenhouse gas emissions stem from fossil fuel use for industrial heat[1]

H_2 Hydrogen

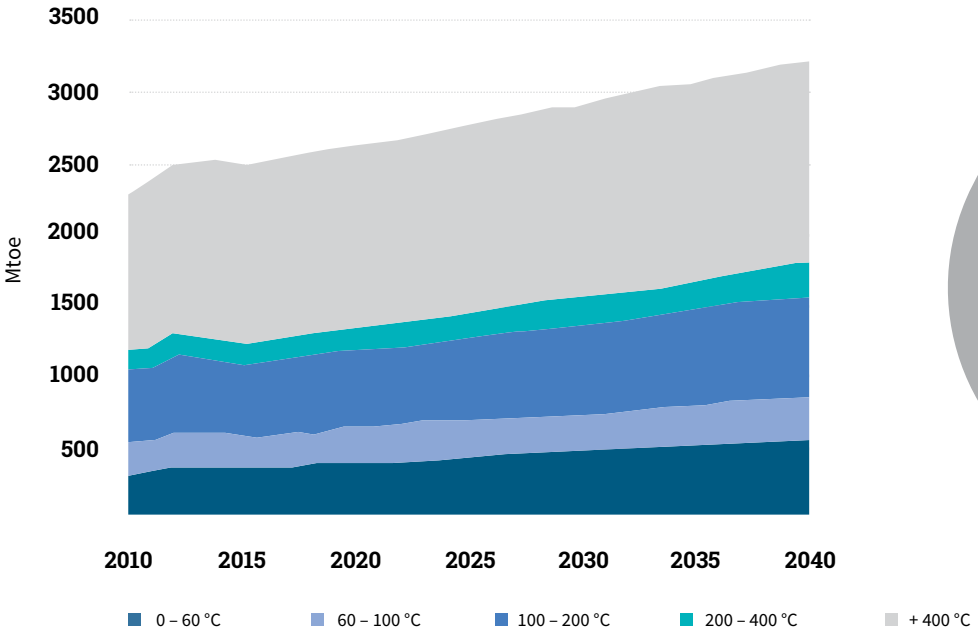
Synthetic Methane

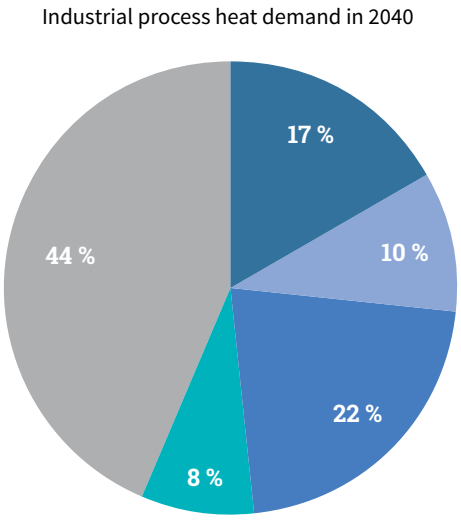
Synthetic Methanol

- Opportunity to decarbonise high temperature and other not-easily electrifiable industrial applications
- Easy integration into existing production processes, technical devices, and infrastructures
- Continued use of mature technologies (e.g. industrial furnaces and furnace burners) and proven industrial-scale processes

- Has still high overall costs: cost drivers are investment costs and cost of (renewable) electricity
- CO_2-neutrality depends on use of renewable electricity and renewable carbon sources

Global industrial demand by temperature level and sector





Energy demand for industrial heat is expected to raise by around 40 per cent from today's 2250 Mtoe[3] – about 20 per cent of worldwide energy demand – to 3250 Mtoe in 2040[1].

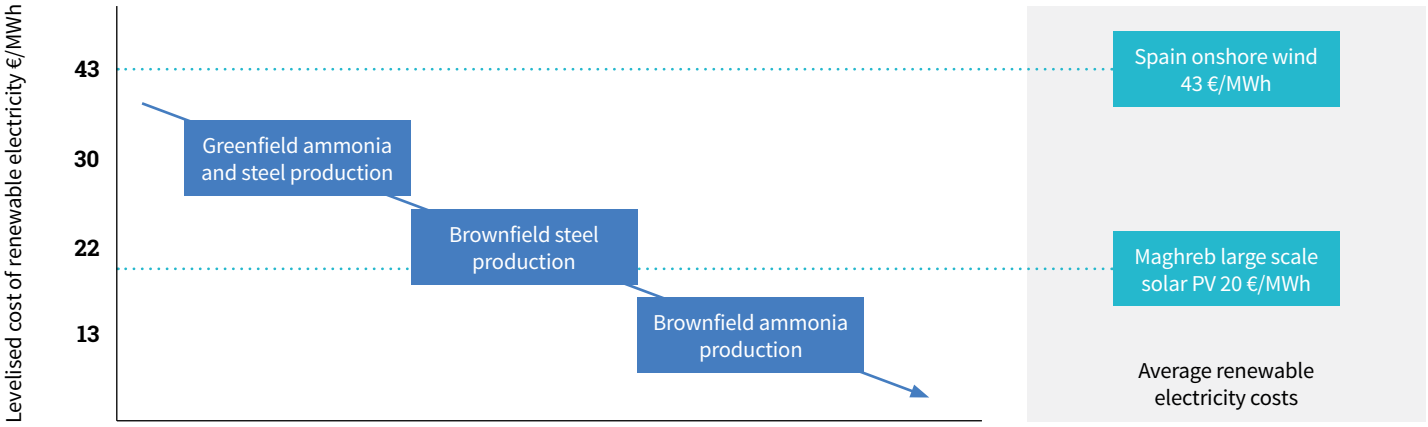
Industrial heat demand can be classified based on the required temperature levels. About 50 per cent of the demand is for high temperature heat (temperatures over 400 °C), around 25 per cent for medium temperature heat (100 to 400 °C) and the remaining 25 per cent for low temperature heat (less than 100 °C)[4]. High temperature processes are mostly used in energy-intense industry sectors like ceramics, glass.

From today's technological perspective and in order to meet the future demand of high temperature process heat in a climate friendly manner, fossil fuels have to be replaced by carbon-neutral fuels like powerfuels.

Decarbonisation approaches based on industrial electricity prices[5]

Today, the use of Carbon Capture and Storage (CCS) is considered the most economic decarbonisation option for industrial installations. However, in many countries worldwide, CCS is either technologically not feasible and/or socially not fully accepted. At the same time, with levelised cost of electricity (LCOE) from renewable energy sources continuously decreasing, decarbonisation by powerfuels gains more and more attractiveness over the use of fossil resources combined with CCS. With LCOE between 20 and 40 EUR/MWh for new power generation plants from renewable energy sources in favourable regions globally, powerfuels have reached cost-competitiveness in many applications in ammonia and steel production. It is then for example cheaper to use green hydrogen for fuel at newly-built ammonia or steel plants designed around hydrogen than to use CCS.[5]

Powerfuels will thus play an important role in decarbonisation of important industrial sectors like manufacture of non-metallic mineral products, including manufacture of ceramics as well as glass and glassware.



Cost competitive green hydrogen industrial usage compared to CCS

Source: McKinsey, 2018

1 IEA, 2018. **2** Schmied, Wüthrich, Zah, & Friedl, 2015. **3** Mtoe – Million tonnes of oil equivalent. **4** IEA, 2017. **5** Results presented are based on (de Pee, Pinner, & Roelofsen, 2018). **References:** de Pee, A., Pinner, D., & Roelofsen, O. (2018). Decarbonization of industrial sectors: the next frontier. McKinsey & Company; IEA. (2017). World Energy Outlook 2017. Retrieved from http://public.eblib.com/choice/publicfullrecord.aspx?p=5160837; IEA. (2018, January 23). Commentary: Clean and efficient heat for industry. Retrieved June 5, 2019, from https://www.iea.org/newsroom/news/2018/january/commentary-clean-and-efficient-heat-for-industry.html; Schmied, M., Wüthrich, P., Zah, R., & Friedl, C. (2015). Postfossile Energieversorgungsoptionen fuer einen treibhausgasneutralen Verkehr im Jahr 2050: eine verkehrstraegerueber-greifende Bewertung. Umweltbundesamt, (30).

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