IEA Bioenergy

Thermal gasification based hybrid systems

IEA Bioenergy Task 33 Special Project

Summary Series

IEA Bioenergy: Task 33: 10 2018

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Edited by: IEA Bioenergy Task 33

Thermal gasification based hybrid systems

Thermal gasification of biomass and waste is a multi-purpose, CO_2 neutral technology, which enables production of renewable heat and electricity as well as biofuels and chemicals.

In this IEA Bioenergy Task 33 special report, the attention was given to production of renewable gaseous and liquid biofuels in combination with renewable hydrogen from surplus electricity. The motivation of this report are the rapidly decreasing prices of solar- and wind energy as well as the possibility of the surplus electricity storage in form of renewable fuels (called also electrofuels).

It was shown, how the excess electricity, which could not be fed into the grid immediately in order not to be overloaded, could be converted to hydrogen using electrolysis and stored or further used together with the gas from thermal gasification for the boosted production of renewable gaseous and liquid biofuels of a high quality.

Pilot and demonstration projects on Power-to-Gas (PtG) and Power-to-Liquids (PtL), which are based on thermal biomass gasification or where the thermal gasification could be employed as a source of carbon oxides, complete this IEA Bioenergy Task 33 special report.

POWER TO GAS

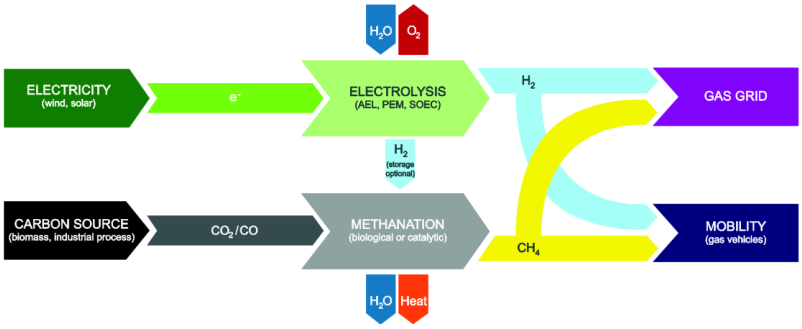

Figure 1: Power to gas process chain [1]

PtG is referred to as a system solution due to its many cross-sectoral applications and the various

[1] Goetz M., Lefebvre J., Moers F., McDaniel Koch A., Graf F., Bajohr S., Reimert R., Kolb T.: Renewable Power-to-Gas: A technological and economic review, Renewable Energy, Vol. 85, 2016, 1371-1390

technologies it employs. The idea behind PtG is to convert an excess of electricity from renewable energy sources (e.g. wind and/or solar) to hydrogen or to methane. The renewable gas can be transported in the existing gas infrastructure (in case of SNG production), stored and then used in a range of applications.

It was shown in the report, that the coupling of solid oxide electrolysis cells (SOEC) with catalytic methanation enables an efficiency up to 80% (based on HHV). Anyway, a major factor of the economic efficiency of PtG plants are the investment costs for electrolysis and methanation. For economic feasibility, relevant annual operational times and low electricity prices are obligatory.

POWER TO LIQUIDS

Power-to-liquids (PtL) is a next possibility how to use an electricity surplus from renewable volatile energy sources in a combination with carbon oxides to produce liquid biofuels (focus on Fischer Tropsch liquids and methanol), which could be used in aviation, ship transportation, heavy load transportation and anywhere, where fuels with high energy density are absolutely necessary. A significant advantage of the FT gasoline and diesel is the fact that they could be used in already existing filling stations immediately and without further investment costs. FT kerosene can be used in aviation. For methanol there is not such an infrastructure as for gasoline and diesel, anyway, it could be converted to gasoline (Methanol-to-Gasoline), which could be used there without any doubts.

As can be seen in the report, the combination of renewable hydrogen from surplus electricity with carbon oxides from gasification enables to double the production of liquid biofuels.

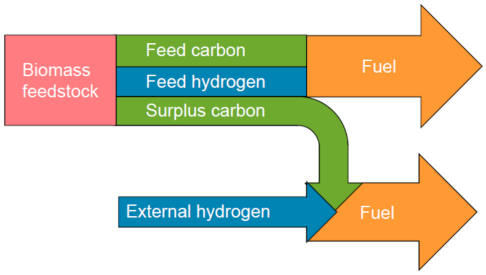

Figure: Boosting the production of liquid biofuels using an external hydrogen

Conclusions

Thermal gasification as a source of carbon for electrofuels production (PtG and PtL) offers a great possibility of technologies and products synergies and although the renewable hydrogen access is not essential for the gasification process, it boosts the amount of final product (fuel) significantly.

In this way, it is possible to kill two birds with one stone; it means to solve the problem with storage of cheap excess electricity from wind and solar power in form of hydrogen, which is able to boost the production of liquid and gaseous fuels from thermal gasification. The biofuels produced in this way are renewable, CO_2 neutral and of high quality, and therefore suitable for e.g. aviation.

Even if the biofuels price is still higher that of the fossil ones (2-3times), it is time to go finally this way of renewable and CO_2 neutral fuels because the clock is ticking for climate change!

Link: http://www.task33.ieabioenergy.com/content/Task%2033%20Projects