WIVA White Spots for the next call for tenders

Green Energy

Feed-in and feed-out of green hydrogen

In order to use the existing gas network, methanisation can play an important role for many applications. Four projects (Renewable Gasfield, Underground Sun Conversion, Carbon Cycle Economy Demonstration, HyWest) on this topic are currently being worked on within the Energy Model Region. As there are different methanisation technologies, further projects can be submitted if they make a significant improvement (for different target parameters) of the processes possible. Moreover, technologies for a pure hydrogen feed-out are strongly required. Elevated amounts of green hydrogen may be transported via the existing natural gas pipeline network across Europe. By applying suitable feed-out technologies, the hydrogen share of currently less than 10 vol% can be extracted, purified to a higher quality (e.g. 5.0) and compressed to the required pressure; technology research and demonstration should be targeted.

Local and regional energy hubs based on Green Hydrogen

The increased use of renewable energy plays a major role in the change of the energy system. Due to high fluctuation of renewable energy production, storage is needed to fulfill the need. Batteries are one option but especially for long time storage, hydrogen can play a major role. Up to now mainly large-scale systems are researched and developed but as decentralized energy production are key players for an energy transition small scale systems for communities and households based on electrolyzers, fuel cells and related storage components are needed for a broader use of green hydrogen.

There is a high demand for research and demonstration of decentralized hydrogen applications in terms of integration in existing energy production facilities, networks, optimizing system efficiency, cost reduction by economies of scale and the development of new technologies. Additionally, sector coupling approaches need to be focused especially in terms of excess heat usage from hydrogen system components as electrolyzers and fuel cells. Integration of green hydrogen in existing energy infrastructure, as well as a sector coupling approach would lead to a new energy landscape based on green sources.

Simulation models and tools for system design as well as the development of energy management algorithms need to be built, the regulatory framework needs to be adapted and financing and funding schemes need to be designed.

Systems based on the production, storage and usage (back-conversion) of green hydrogen can increase the speed of the energy transition as positive effects as the share of renewables in the local energy grids can be raised significantly. If the necessary hard- and software is developed a high positive influence by corresponding grid supporting measures could be made.

Power-to-Gas/Liquid & Gas/Liquid-to-Power/Heat

In order to decrease the costs of green hydrogen production, there is still a lot of research needed concerning the different components of an electrolyser system as well as the stack itself. Furthermore, there is also a lot of potential to increase lifetime by maintaining or even increasing efficiency. The scale-up of electrolysis technology should further include research on manufacturing and improved functionalities. In parallel, conversion of hydrogen into power (electricity) and heat (e.g. in CHP plants) has to happen at best efficiency and lowest costs. Most suitable conversion technologies for different applications need to be identified and further

improved and tested also regarding minimum total environmental impact (on a cradle-to-grave basis incl. LCA aspects).

In addition to battery-electric and hydrogen-powered powertrains, powertrains powered by synthetic gas and fuels based on regeneratively generated electricity, on CO2 from biogenic sources and using a Power to Gas/Liquid process enable CO2-neutral mobility.

In order to minimize the energy needed for the production of synthetic gas/fuel, the efficiency of all process steps involved need to be further improved. Same is true for the conversion vice versa.

Furthermore, alternative production routes for hydrogen and synthesis gas, which bear the potential to utilize other energy sources (heat, biomass etc.) efficiently, should be considered and developed further (e.g. SOEC, biomass-based hydrogen).

Green Mobility

Hydrogen fuel cell components and systems for affordable FC-electric vehicles

Electric vehicles with hydrogen-powered fuel cell systems enable long ranges, short refueling times, good driving performance and offer a high utility value. The challenge is to develop more efficient, durable and cost-effective fuel cell components and systems with improved dynamic performance and low noise emissions. These components and systems should be the basis for a local (supply-)industry nestled in the hydrogen model region, thus, creating a sustainable society (with reduced/low energy needs for transport of employees and goods) also from an employment/economy view.

Hydrogen for heavy-duty transport

Only by means of fuel cell systems electrified heavy-duty vehicles can be represented, which offer a high utility value and can therefore be used economically. This applies to all areas of heavy goods traffic on the road, rail and water as well as all areas in which special vehicles are used (construction, mining, airport apron etc.). Moreover, this applies also to special means of transport and heavy-duty applications in tourism and public transport applications. For these applications, fuel cell systems – including the components as well as efficient development tools for reduced time-to-market - must be developed that meet the high robustness and durability requirements.

During the transition phase, technologies enabling a full conversion of actually fossil fuel-based propulsion systems to systems fueled by hydrogen should be developed and quickly introduced to the market in order to scale up the hydrogen-demand for heavy duty transport (road, rail, waterborne) quickly.

Hydrogen infrastructure and CO_2-free logistics

Potential projects should comprise the research, development and demonstration of zero-emission mobility from tank-to-wheel in combination with lowest CO2 well-to-tank solutions. The different modes of transport can comprise water and land transport, which includes ships, rails or railways, road and off-road transport. Moreover, the solutions developed may be designed for both urban and rural areas. In particular innovative transport and storage concepts for the efficient distribution of large hydrogen volumes are needed. In order to foster a fast market penetration of CO2-free solutions, a technology neutral approach should be also considered enabling a (at least partial) conversion of existing technologies (i.e. conventional trucks in H2-ICE powered trucks).

The goal is the development and demonstration of zero-emission freight logistics scenarios (e.g. trucks, delivery vans, last mile, industrial trucks etc.), including the use of locally zero-emission

vehicles and integration of appropriate refueling infrastructure solutions. The development, integration and testing of fuel production and refueling infrastructure solutions as well as operational demonstration are crucial. Next to the use of hydrogen in logistics infrastructure the application in intralogistics has a major potential in CO2 reduction. There is a need for the development of hydrogen fueled intralogistics carriers and corresponding refueling infrastructure. Especially when compared to conventional battery powered systems or conventional fueled vehicles in heavy duty applications, hydrogen has the potential in increasing the usability and efficiency of these vehicles and systems with simultaneous reduction of operational and overall emissions. The economic sustainability of the development, as well as the option to transfer to regular operations, must be demonstrated at the end of the project period. The involvement of industry logistic partners, public transport providers, mobility services or fleet solutions are welcomed.

Green Industry

There are a number of existing industrial processes which are based on gaseous energy carriers or which are also based on hydrogen from fossil sources or use it in industrial processes. The transition to green industrial processes therefore requires an accelerated changeover in this respect as well. Projects in various sectors of the economy are needed to facilitate this transition to the use of renewable hydrogen in the process. In this context, however, on the one hand a clear need for research and development is necessary and on the other hand a demonstration of the changeover is required.

Green hydrogen in (current) industrial processes

Hydrogen is already used today for many industrial processes mostly obtained by steam reformation from natural gas. Projects using green hydrogen (eg. H2Pioneer, UpHy) must be demonstration projects with corresponding business models. The development of cross-sectoral integrated concepts with multiple green hydrogen applications shall enable competitive cost structures for the production of green hydrogen. Special topics in this dimension are, on the one hand, high-temperature processes that require special requirements, but also the coupling of specific energy flows in the overall process including re-electrification. In addition, industrial processes that require carbon capture are also relevant in this context, especially in terms of subsequent carbon utilization with the simultaneous use of green hydrogen. The integration of certification systems for green H2 in industrial processes are required to facilitate the application of green hydrogen.

New technology for the use of hydrogen

Based on hydrogen, completely new processes can be developed in industrial processes. One example is the SuSteel project. For specific companies, such as in steel production, it is already foreseeable that current industrial processes will have to be converted to renewable gases such as hydrogen for a transition to CO2-free processes. This also requires new broad approaches, which are relevant in this White Spot. However, R&D for new technologies is explicitly focused on those processes that have no other viable alternative for a transition to CO2-neutral production than via renewable hydrogen.