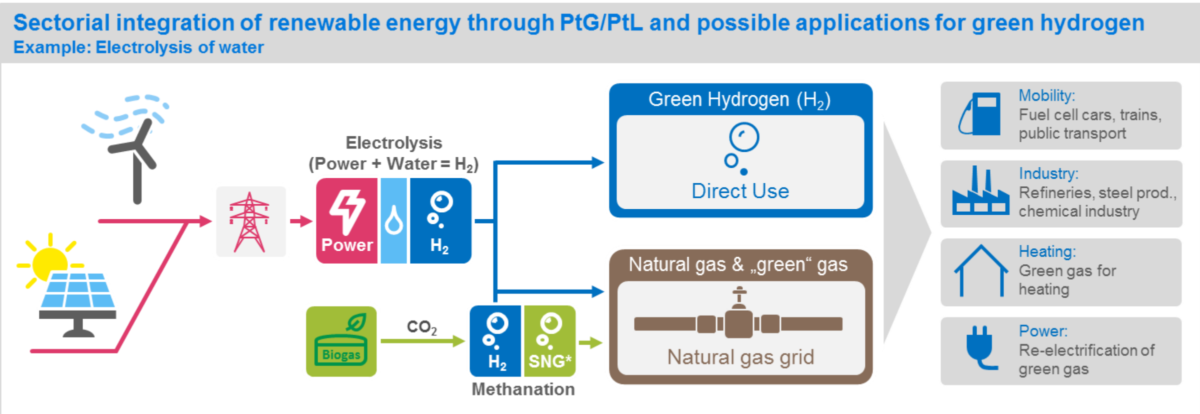
EASE Recommendations on Sectoral Integration Through Power-to-Gas/Power-to-Liquid

May 2017

Increasing the power generation from renewable energy sources (RES) and decarbonising Europe's energy system are the main targets of today's energy policy in Europe. Both Power-to-Gas (PtG) and Power-to-Liquid (PtL)[1] allow using electricity generated from RES to produce Green Hydrogen[2] and other energy carriers. This will help to reduce greenhouse gas (GHG) emissions by substituting energy from fossil sources. Since PtG and PtL are able to be produced flexibly, they can provide additional flexibility to the electricity grid and thereby support the integration of intermittent renewable generation as well as the deployment of additional RES installed capacity. Furthermore, PtG and PtL are key technologies for sectoral integration (sector coupling), i.e. improving the link between different energy and economic sectors, thereby increasing the overall efficiency at energy system level while contributing positively to energy security.



*SNG = Synthetic Natural Gas

Source: Uniper, 2017

[1] Power-to-Gas and Power-to-Liquid are used to describe the production of hydrogen or – using recycled CO_2 – synthetic natural gas (SNG), methanol and/or follow up products like synthetic gasoline via the MTG (methanol to gasoline) process or other synthetic fuels like DME (dimethyl-ether) and OME (oxy-methylene ether). Also synthetic ammonia from green hydrogen and nitrogen is considered as a carbon neutral fuel.

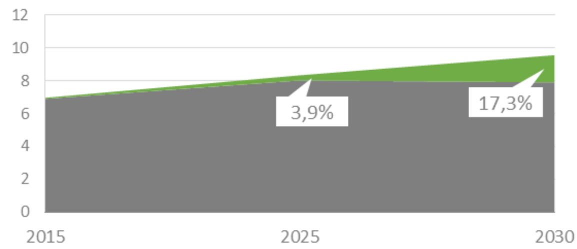
[2] The term "Green Hydrogen" is used inclusively for all pathways to produce low-carbon hydrogen from renewable sources and follows the definition of the Project CertifHy for Green Hydrogen (renewable and low-carbon) and low-carbon hydrogen. The development of a certification system for all these pathways to produce hydrogen and follow up fuels/components as proposed by Project CertifHy is supported by EASE. (http://www.certifhy.eu/79-slideshow/121-goo-reason.html).

EASE – European Association for Storage of Energy
Avenue Adolphe Lacomblé 59, BE-1030 Brussels – tel: +32 (0)2.743.29.82 – @EASE_ES – info@ease-storage.eu – www.ease-storage.eu

The use of PtG and PtL combines the following key advantages:

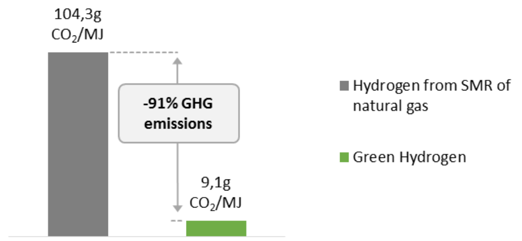
- Integration of renewable electricity into various sectors of the energy system, which supports the objectives of the "Clean Energy for All Europeans" Package and the long-term vision of the Energy Union;
- CO_2 emission reduction[3] by substituting fossil based hydrogen from steam methane reforming of natural gas;
- Provision of flexibility to the electricity grid by integration of variable generation of RES and the provision of balancing energy;
- Ability to be used in multiple setups, such as industry (refineries, steel production, fertiliser production), mobility, and heating;
- Ability, in the long run, to be used to store energy in the form of gas or liquids to absorb surplus electricity or to be used to generate electricity for backup purposes or at times of peak pricing;
- Ability, in the short run, to be used in industrial processes (chemical industry, refineries) and mobility;
- It is the only energy storage option available to store large amounts of energy seasonally and provide it on-demand to different sectors and applications.

About 17% of all hydrogen could originate from renewable and/or low-carbon sources by 2030, representing a market of about 1.7 million tons of Green Hydrogen per year.



Source: Project CertifHy; Hinicio 2016

Green Hydrogen has a 91% lower carbon footprint compared to hydrogen from steam methane reforming (SMR) of natural gas.



Source: Directive (EU) 2015/652

In order for PtG and PtL to be available for large scale applications (i.e. industries, mobility) by 2030, progress needs to be made in several areas, including the necessity to insure safety: PtG and PtL installations need to be scaled up, efficiencies have to be further increased, and production costs, for e.g. electrolysers, need to be reduced. Sector specific market and regulatory frameworks need to be further developed and barriers need to be overcome where they exist in order to tap the full potential of these technologies.

This progress can be achieved with the following steps:

- **Creating a level playing field for Green Hydrogen and other follow-up products** in a similar way to biofuels, blending not only directly in mobility but also when used in the production process of fuels. In this way, PtG and PtL could be used already today to reduce emissions in the production process of fuels or their blending components, like

[3] GHG intensity in gCO_{2eq}/MJ according to Directive (EU) 2015/652, Annex I, Part 2 (5)

methyl tertiary butyl ether (MTBE) or methanol, or during production of synthetic gasoline from Green Hydrogen.

- **PtG and PtL have very small carbon footprints and require little land** compared to conventional (first generation) biofuels. Advanced biofuels entail exactly these characteristics. Green Hydrogen and follow-up products from PtG and PtL could therefore be recognised as advanced biofuels.
- **First large-scale applications will trigger cost reductions and allow for a spill-over effect** to other applications such as mobility and other industries.
- **Framework conditions need to be created which allow innovative technologies to enter the market.** These include allowing customers who are willing to use high shares of renewable electricity to do so already today and to avoid mandatory grid mix (EU- or Member State-level) models.

These developments can lead to a future Green Hydrogen/green synthetic fuel economy. However, some key regulatory barriers are still blocking such developments. To overcome these hurdles, we recommend the following measures:

1. **Developing a certification system** for production pathways of Green Hydrogen and Green Synthetic Fuels. Such a system could be designed on the basis of the Project CertifHy recommendations.
2. **Developing comprehensive and fair life cycle assessment (LCA) methodologies** for assessing GHG emission savings from renewable and low carbon fuels in the overall system to evaluate an adequate remuneration scheme for those savings.
3. **Promoting sectoral integration** by reducing the barriers between the different energy and economic systems (mobility, industries, heating, etc.). This includes especially those fees and taxes applied when energy is transferred from one sector to another.
4. **Developing a coherent remuneration system** for flexibility services.
5. **Creating a level playing field for Green Hydrogen and green fuels/blending components** when used in refineries or during the fuel production process by classifying them as advanced biofuels under the revised Renewable Energy Directive (RED)[4].
6. **Reducing the economic gap** by promoting, especially through EU funds, the development of pilot projects.

[4] RED: Renewable Energy Directive (2009/28/EC); RED recast: COM(2016) 767 final from 30.11.2016

Background Information

1. General

PtG and PtL are innovative applications of the proven water electrolysis technology to produce hydrogen or synthetic natural gas (SNG) with a subsequent methanation step or synthetic fuel (SF) like methanol with electricity from RES. There are several use cases for Green Hydrogen short- to mid-term, especially in the transport sector and the chemical industry. In the long-term, hydrogen can act as a seasonal storage for renewable energy. From an economic point of view, this is feasible if RES are the dominant source of energy and if the carbon pricing mechanisms deliver appropriate investments signals.

With regard to the current ambitious GHG emission reduction targets and future mandate on the minimum shares of low carbon and renewable fuels in the transport sector, Green Hydrogen contributes in several ways:

- Green Hydrogen can be used directly in the production process of fuels, thereby replacing conventional fossil hydrogen from steam reformation of natural gas which has high GHG emissions;
- Green Hydrogen and Low Carbon Synthetic Fuels such as methanol can be used in mobility;
- SNG and SF from Green Hydrogen can drive existing internal combustion engine (ICE) vehicles, including natural gas vehicles (NGVs).

2. Advantages of PtG/PtL

PtG and PtL installations use electricity from RES. Flexible and fast-reacting electrolysers can quickly increase their production in times of surplus electricity. This mitigates curtailment of wind farms and helps avoid grid congestion and stabilise the electric grid. At the same time, in a future with more RES integration and less surplus electricity, these installations will contribute to the "additionality principle" whereby they incentivise in a market oriented manner the deployment of more RES installed capacity, supporting the long-term vision of the Energy Union.

Green Hydrogen produced with electricity has significantly lower land use compared to biomass based fuels. Furthermore, there is no indirect land use change (ILUC) caused by Green Hydrogen. The carbon footprint of Green Hydrogen is low. With a transparent and credible certification system (Guaranties of Origin are under preparation), hydrogen and other follow-up products can contribute to achieving European decarbonisation goals for transport and industry sectors. Green Hydrogen production is national or even local, reducing Member States' dependency on fossil fuels in the different economic sectors. Thus, Green Hydrogen and follow up products also contribute to overall security of energy supply. There are existing markets for hydrogen, natural gas, and methanol. Green Hydrogen, SNG, and SF also can be used in the existing infrastructure.

EASE – European Association for Storage of Energy
Avenue Adolphe Lacomblé 59, BE-1030 Brussels – tel: +32 (0)2.743.29.82 – @EASE_ES – info@ease-storage.eu – www.ease-storage.eu

Green Hydrogen used in the production process of fuels (diesel and petrol) does not change the chemical composition of the final product and is a short to medium-term option without changing existing infrastructure or vehicle engines. It represents a “soft” turnaround towards renewable fuels, and high public acceptance can be expected.

Advanced biofuels and traditional biofuels will complement each other in the period up to 2020. The total share of low-carbon and renewable fuels required in the future can only be met by a combination of traditional biofuels and advanced biofuels. As such, existing investments or industries will not be harmed.

Electrolysis of water is a mature technology which has been used for several decades. New materials and technologies offer efficiency improvements as well as cost-degression potentials. Today, however, Green Hydrogen is in competition with conventional, fossil-based hydrogen. Supporting the integration of Green Hydrogen into existing hydrogen markets would provide a stable environment for companies to invest in electrolysis technologies, thereby creating a solid basis for the further development of applications, such as energy storage.

3. Policy recommendations

1. **Developing a certification system** for production pathways of Green Hydrogen and Green Synthetic Fuels. Such a system could be designed on the basis of the Project CertifHy recommendations.
2. **Developing comprehensive and fair life cycle assessment (LCA) methodologies** for assessing GHG emission savings from renewable and low carbon fuels in the overall system to evaluate an adequate remuneration scheme for those savings.
3. **Promoting sectoral integration** by reducing the barriers between the different energy and economic systems (mobility, industries, heating, etc.). This includes especially those fees and taxes applied when energy is transferred from one sector to another.
4. **Developing a coherent remuneration system** for flexibility services.
5. **Creating a level playing field for Green Hydrogen and green fuels/blending components** when used in refineries or during the fuel production process by classifying them as advanced biofuels under the revised Renewable Energy Directive (RED)[5].
6. **Reducing the economic gap** by promoting, especially through EU funds, the development of pilot projects.

[5] RED: Renewable Energy Directive (2009/28/EC); RED recast: COM(2016) 767 final from 30.11.2016

***

About EASE:

The European Association for Storage of Energy (EASE) is the voice of the energy storage community, actively promoting the use of energy storage in Europe and worldwide. It supports the deployment of energy storage as an indispensable instrument within the framework of the European energy and climate policy to deliver services to, and improve the flexibility of, the European energy system. EASE seeks to build a European platform for sharing and disseminating energy storage-related information and supports the transition towards a sustainable, flexible and stable energy system in Europe.

For more information please visit www.ease-storage.eu

***

Disclaimer:

This response was elaborated by EASE and reflects a consolidated view of its members from an Energy Storage point of view. Individual EASE members may adopt different positions on certain topics from their corporate standpoint.

***

Policy Contact: Brittney Becker | EASE Policy Officer | b.becker@ease-storage.eu |+32 (0)2 743 29 82