Newsletter

February 2021

LET'S SHAPE THE FUTURE OF ELECTRICITY AND ENERGY.

EDITORIAL

By Thibaut Griboval

2020 has been an extremely challenging year for everyone. Many associations faced difficulties and had to cancel or postpone their main events. KBVE/SRBE was one of these associations.

In this context, I have joined the association as Secretary General. I quickly noticed the passion and commitment of the members, followers and administrators towards the association. This commitment allowed us to go through the crisis and organize the very first online study days.

This event, hosted by our Chairman of the Scientific & Technical Committee Daniel Ladang and Prof. Patrick Hendrick from ULB gathered more than 80 participants online from the 27th November to the 18th December 2020.

Around the trending topic of hydrogen, KBVE/SRBE had the pleasure to welcome 16 speakers from renowned organizations such as Elia, Federaal Planbureau, Siemens Energy, Fluxys, Alstom, VanHool, Engie, UCLouvain and UGent.

More than a classic study day, this event was the occasion to show that our association is able to reinvent itself and find alternatives in order to keep a strong link with its community in a difficult environment. In 2021, we will need to pursue our efforts of digitalizing our content and events. That is why we are delighted to announce that our agenda will be filled with events in the coming months, even at distance!

We will organize more digital events, we will get in touch with you through our social networks and we will partner with other organizations to continue our reshaping process.

We want KBVE/SRBE to be your favorite place to discuss electricity and energy related topics. That is why we need you to support us this year, share your feedbacks and shape the future of energy!

Thibaut Griboval

AGENDA

In 2021, SRBE/KBVE will organize new types of events with more digital occasions to meet up. Trending topics will also be added to the agenda of this year, such as cybersecurity, energy transition and local communities of energy.

In its ambition to provide more content, gather its members in safe conditions and adapt to the new trends of our society, SRBE/KBVE is currently preparing an innovative agenda with webinars, new digital formats and new collaborations. The association will soon communicate its entire agenda for 2021, that will include the following events and study days.

Q1 2021

- **E Review "New Knowledge on Solar Storms and their Potential Effects on the Belgian HV Power Grids"**
- **Announcement of the Sinave Award 2020**
- **Digital Event SRBE/KBVE 2.0**
- **Cybersecurity (To be confirmed)**

Q2 2021

- **Balancing the grid**
  in collaboration with Horizon238 and students associations
- **Local communities of energy**
  in collaboration with Sia Partners

Q3 2021

- **Medium & High Voltage substations**
  in collaboration with SEE

JOIN US!

Join SRBE/KBVE in 2021 and be part of a journey to shape the future of energy.

As a member of our association you will **enjoy unique benefits, such as the possibility to attend exclusive seminars** where you can **gain and share new knowledge in the sector**, **build your reputation** and **expand your network** by attending our Study Days.

Moreover, **our journal the "Revue-E-Tijdschrift" is an ideal way to keep updated** about the latest developments in the sector as well as on all tangent topics. Each individual member of SRBE/KBVE receives the "Revue-E-Tijdschrift and the invitations to the various events of the Society.

Each member also enjoys **preferential conditions for participation in the Study Days** or when ordering publications published on these occasions.

In 2021, KBVE/SRBE has decided to propose exceptional conditions to the young generation: the membership will remain free for all students (subscription by email) and will be reduced at 39€ VAT excl. for the recent graduates!

Moreover, for a renewal of your contribution or the purchase of a new contribution before February 15, 2021, you benefit from a 10% reduction!

To order now on our website (the price displayed on the site is the total amount, the reduction will be taken into account in the shopping cart):

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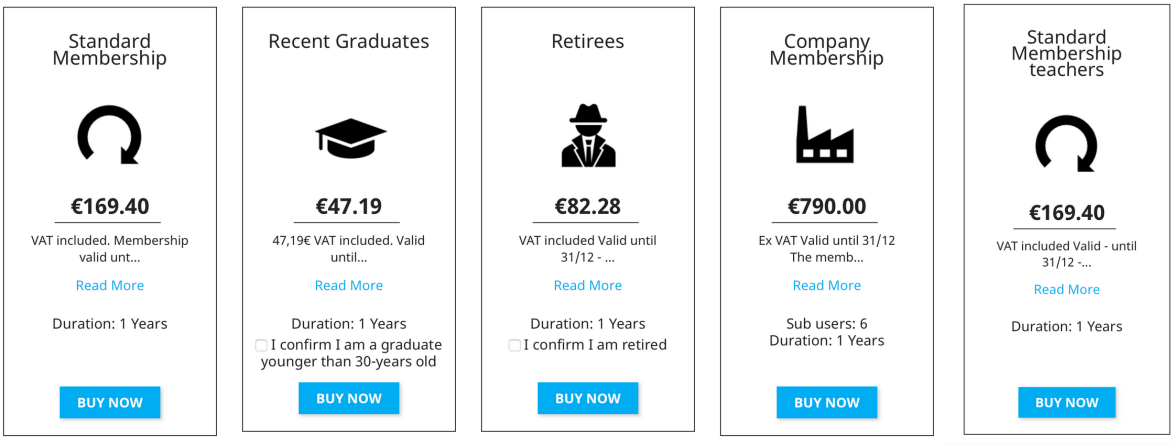

SPONSORSHIP

Support SRBE/KBVE in 2021 and link your brand to a renowned Belgian association!

Supporting the SRBE-KBVE allows the association to **organize exclusive seminars, conferences, webinars and study days** for our large community in Belgium and also with our partners abroad. During these events, the association shares **high quality insights and technical information, through the presentation of renowned experts**.

By associating your company and its brand to our events, **you will benefit from this exclusive positioning in Belgium** and **increase your visibility to a wide range of energy experts** of various types. You will also be visible on all our external communication supports and platforms (Event invitations, Announcements, Website, LinkedIn, Twitter...).

Moreover, by supporting our association, **your engineers and experts will have the occasion to present the topic of their choice** during one of our conference or study days.

Please feel to contact us to discuss the possibilities and associate our brands for the good of the energy and electrical sector in Belgium!

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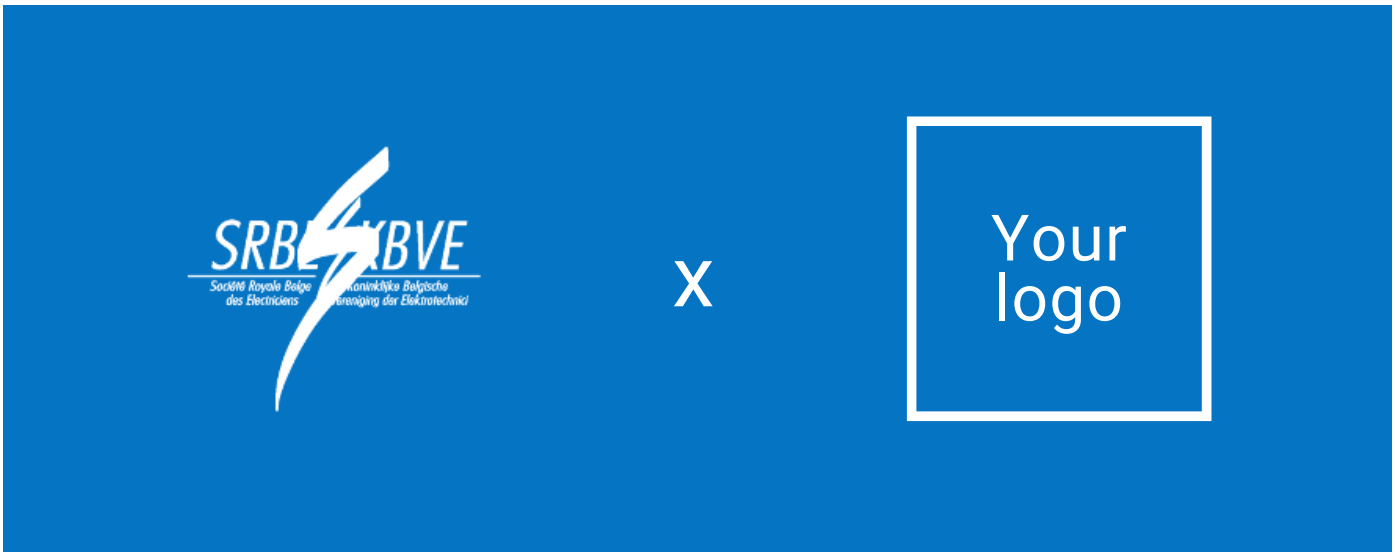

E REVIEW : "NEW KNOWLEDGE ON SOLAR STORMS AND THEIR POTENTIAL EFFECTS ON THE BELGIAN HV POWER GRIDS"

The SRBE/KBVE will publish in the coming weeks the the first 2021 edition of its E-Review. Raf Steyaert provides us more information about this publication from the SRBE/KBVE Ad Hoc Working Group.

About five years ago, SRBE/KBVE dedicated an issue of its E Review to solar storms and their potentially disastrous impact on electricity grids, a phenomenon with which electricians in our regions are not so familiar.

At that time, the solar activity during the so-called solar cycle 24 reached a maximum and came to an end in 2019. Currently, the sun is starting a new cycle of about 11 years, cycle 25. While cycle 24 was very mild - one of the weakest in almost 100 years - it is impossible to predict how intense the new cycle will be. Scientists around the world are making great efforts to better understand and predict solar activity.

The aim of this review is to provide new insights into the physical mechanisms at the origin of solar storms and how they can affect the earth's electricity grids. It also assesses and quantifies the risk of such storms for electricity grids based on the measurement data recorded by the Dourbes Geophysical Observatory over the past three decades.

Johan Van Baelen summarizes in the first article entitled **'Additional insights in the geomagnetic storm environment for high voltage power grids'** the main achievements of the working group.

Jean Louis Van Eck presents in the second article 'Calculation of the electric field induced in the ground of Belgium during a potential solar storm' a simple approximate calculation method that expresses the relationship between a linear variation of the geomagnetic induction and an order of magnitude of the maximum electric field induced at the earth's surface.

From the measurements of the geomagnetic induction recorded in the Dourbes observatory during the past three decades and using the simplified calculation method of the previous article, Jean Louis Van Eck determines in the third article **'Currents induced in high-voltage lines by some solar storms'** to which induced currents storms observed during this period could have given rise.

Albert Van Ranst evaluates and quantifies in the fourth article **'Potential effects of geomagnetic induced currents on power grids in Belgium'**, the risks that the storms recorded over the past thirty years could have posed to the Belgian grid, using the results obtained in third article.

I would like to express my sincere thanks to the authors of the articles for their highly valued contributions. But also many thanks to all members of the Ad Hoc Working Group for their expertise and support in the creation of this issue and especially for the inspiring cooperation over the past years.

Raf Steyaert

The Ad Hoc Working Group includes Ir. J. Hoeffelman, Prof. Em. R. Poncelet (ULB), Dr. Ir. J. Rimez (Elia), Ir. J. Van Baelen, Prof. Em. D. Van Dommelen (KU Leuven), Prof. Em. Jean Louis Van Eck (ULB), Ir. A. Van Ranst.

TRENDS & STRATEGY

By Joris de Meulenaere & Kevin Snyers

This report is a summary of the first session on "Power-to-Molecule". An insight on the future, strategic vision and the roadmap for renewable "green" hydrogen.

1. The Future of Hydrogen, some viewpoints and perspectives from the International Energy Agency (IEA) - Pr. Joris Proost, UCLouvain

Why and how?

Existing infrastructure is CO2 intensive and will continue to emit CO2 in the next 50 years. Assuming typical lifetimes and operating regimes, the cumulative emissions from existing energy infrastructure could reach nearly 750Gt CO2 by 2070. In order to respect to 2°C limit that was set as a maximum, there is no more room to increase current emissions as they should decrease to 0 by 2070. Renewable hydrogen is one of the options to limit these CO2 emissions.

Together with technologies like bioenergy, avoided energy demand, renewables, technology performance, carbon capture and others, hydrogen will play a vital role in the CO2 emissions reduction. Most of these reductions will be gained in the transport sector.

Demand and production.

Most hydrogen is currently produced in a CO2 intensive way, this needs to be prevented by using different methods. Carbon capture and renewable energy supply will play major roles to produce hydrogen in a clean way. By 2070, a 50% split for production is expected and 50% of the expected 520Mt of H2 will be used in the transport sector.

Price & sale

Depending on the region, the choice will have to be made between production by renewable energy, carbon capture or import. These technologies will need to mature in order to drive the price down so that hydrogen can become competitive with carbon based fuel. Due to the high gas prices and limited possibilities for renewable energy, Belgium and the EU will have to import hydrogen and launch the necessary infrastructure works.

2. Strategic H2 vision for Flanders – Isabel Francois, Waterstofnet

Waterstofnet, created in 2009, develops and manages projects and roadmaps for renewable hydrogen. In 2019, the Flemish government started focusing on hydrogen. Hydrogen should play a key role in the economic recovery policy. Plans and ambitions were written down in a vision. The targets include a strong R&D position, a strong support for the hydrogen industrial network, stimulation of the use of hydrogen, international collaboration and the creation of an accommodating policy.

In Flanders, Waterstofnet aims to have up to 50 busses and 300 trucks, running on Hydrogen. This should be made possible by an increase of hydrogen production up to 500MW in 2030. Besides that, more projects are being announced to help the widespread use and acceptance of hydrogen. This is done with the help of the IPCEI program of the EU in order to connect Belgian and Dutch ports with hydrogen producers and customers.

ENERGY SYSTEM INTEGRATION

By Joachim Goovaerts

This report is a summary of the second session on “Power to Molecules”. It offers some insights on the feasibility and usefulness of hydrogen-integration in the European power system..

1. Fuel for the future – more molecules or deep electrification in Belgium’s energy system by 2050 – Danielle Devogelaer (Federal Planning Bureau)

The Belgian Federal Planning Bureau (FPB) conducted research on the place hydrogen can occupy in the future Belgian energy system by 2050. The FPB published a working paper called “Fuel for the future”, analysing two different approaches of hydrogen integration.

This analysis, investigating the impact of more (in)direct electrification on the future Belgian power system, is based on two distinct energy system scenarios:

→ ‘Deep Electrification’, considering a directly electrified future energy system;
→ ‘Diversified Energy Supply’, considering an indirectly electrified future energy system.

In the second scenario, hydrogen is used as a direct energy carrier, whereas in the first scenario hydrogen is used rather as a mean for flexibility. However, even in the ‘Deep Electrification’ scenario, it remains very difficult to directly electrify some applications, such as long distance transport, and reach very high temperatures.

For both scenarios, total power demand increases by a factor up to three compared to today’s levels, towards 2050. Belgium will remain a net importer of electricity in 2050. Only 88% of its electricity-supply will produced domestically, from which about 68% will originate from renewable energy sources, and about 32% from carbon-neutral gas units.

The need for flexible demand differs however for both scenarios: a ‘Diversified Energy Supply’ system requires more flexibility than a ‘Deeply Electrified’ system. For both scenarios, “green” hydrogen proves to be an important energy source. Total yearly demand can even rise to up to 99TWh for a ‘Diversified Energy Supply’ system and up to 80TWh for a ‘Deeply Electrified’ system. If these amounts of hydrogen are to be produced in Belgium, the necessary production capacity, meaning sufficient installations and available renewable energy for electrolysis, has to be present.

In a near future, assessing the energy system based on quantitative analyses will be key. Integration in the entire energy system is also important: not only the power generation side should be tackled, but also the transmission and demand side. Belgium should try to produce renewable energy itself as much as possible, but also take into account import, for example through interconnections and transport of hydrogen.

2. Contribution of the electro- and bio- energy carriers to the Belgian security of supply in 2040 and beyond – Prof. Hervé Jeanmart (UCL)

The mission of the BEST project is to "work out, for Belgium, the most economical electro- and synthetic energy carrier routes needed to face the climate change issues ensuring the stability of the grid and the security of supply in 2040 and beyond."

The project team is conducting a research on the amounts of electrofuels (liquid and gas) required to feed the Belgian energy system before and after the energy transition.

The model demonstrates the need for an import-contribution of at least 16% to the total energy demand in Belgium. It provides the following recommendations on energy consumption, by 2050:

→ Heating- Electrification is useful for lower temperatures, however higher temperatures can only be reached by the use of renewable fuels.

→ Mobility
Private mobility should be powered solely by renewable fuels, whereas public and freight mobility should be powered party by renewable fuels and party by electricity.

This is a recommendation that contradicts the widely supported point of view of a fully electrified private transportation system. The main message of this insight should be that the discussion should include a private transport powered by renewable fuels, instead of focusing solely on electric vehicles.

3. Benefits of long-term storage using power-to-gas – Yves Vercammen (Fluxys)

Yves Vercammen presented a more conceptual approach to the use of hydrogen for mitigation of risks due to power production intermittence. Production intermittence will be an important characteristic of the future power system due to its renewable (electricity) solutions such as wind and solar power generation.

Therefore, the need for flexibility will become a very important driver for the future energy system. A differentiation is to be made between short term and long term intermittence. Short term power production intermittence is already present in today's power system. This already gives rise to serious peaks in electricity prices. These can be maximum price peaks in case of underproduction, but also minimum price peaks in case of overproduction, sometimes even leading to negative electricity prices!

Because of their limited storage capacities, the solutions for short term intermittence are not able to mitigate the risks linked to long term production intermittence. Power-to-gas and gas-to-power can offer solutions. During a long period of overproduction, renewable fuels can be produced from the excess of electricity. These renewable fuels can in turn be used to generate electricity in times of underproduction, or to directly power certain applications.

The Belgian energy system has an interlinked gas- and electricity-network, with an already existing gas-to-power branch. In the future, power-to-gas could create an extra interlinking branch, paving the way for a flexible Belgian energy system due to large-scale storage of energy in the form of renewable fuels.

4. Hydrogen – a power sector's perspective – Nicolas Gielis (Elia)

The EU Green Deal strives for a 100% decarbonised world. This puts an end to all ambiguity, as no country, industry or instance can hide itself behind the last undecarbonised percentages anymore. According to Elia, the transition towards this fully decarbonised world, in terms of the energy system, should be broken up into different steps, each with their chronological priority.

At first, an overall increase in energy-efficiency should be tackled. Notably industrial and construction/domestic applications, such as heating, still offer a lot of potential for efficiency-gains. In a second step, large-scale electrification should be addressed. This for example in mobility-applications, but also in industrial applications, domestic applications…

This electrification-step will also (largely) contribute to the increase of energy-efficiency. Thus, the first step towards energy-efficient applications will many cases directly lead to an electrification of those applications. Full electrification of the entire energy system is however, not feasible.

Green molecules can play a vital role in facilitating these amounts of energy-imports. As the production-costs of green hydrogen are lowest in regions with high availability for renewables, import of green hydrogen could provide sufficient energy to fill the energy-gaps in Europe, at acceptable energy-prices.

However, it is important to remark that use of hydrogen should not be the first reflex. The EU should strive as much as possible to meeting its energy needs by use of its own production capacities. Large-scale electrification has to remain the first priority. Another concern for the energy system of the future is grid stability. The European powergrid will need sufficient flexibility to match the variability and the uncertainty of renewable energy sources.

Unlike the energy system of today, where generation follows consumption, a future energy system where demand will follow generation could offer enough flexibility to obtain a stable power grid, even when electrification has deeply penetrated the European energy system. This means that hydrogen is facing fierce competition for its use a flexibility-enabler for the power grid, as hydrogen will not be the cheapest, nor the most efficient way to achieve flexibility.

Therefore, Elia states that Europe should not use hydrogen as a means to solve problems that do not exist yet in the power grid. It could be used in the future to achieve the last percentages of flexibility, but direct grid solutions should be the first enablers to achieve flexibility of a deeply electrified European energy system. Electricity and hydrogen should not be made to compete with one another, but should both be used where they are most needed and most useful.

TECHNOLOGY

By Jeroen Peeters, Joachim Goovaerts & Kevin Snyers

This report is a summary of the third session on "Power to Molecules". It offers some insights on the potential use of hydrogen in different sectors, such as mobility and industry.

1. Towards a new Carbon-Neutral economy in the Ghent area of North Sea Port – Patrick Lafontaine (CCU hub)

North-CCU-hub conducts research on the development of a carbon neutral economy in the Ghent area of North Sea Port. The energy-intensive industries and companies in this area belong to the innovative world top.

Today however, these industries rely on fossil fuels, even if the area already has easy access to offshore wind energy. The use of green hydrogen offers a CO2 reduction potential of more than 20 million tons of CO2 per year.

Today already 450 000 tons of hydrogen are used in industrial processes in the industrial area of North Sea Port, essentially in the refining and naphtha cracking processes.

This hydrogen is today produced with steam methane reforming (SMR) emitting a lot of CO2. Clearly, green hydrogen offers a huge CO2 reduction potential in the industrial area of North Sea Port.

The Hydrogen Delta Program drives this shift from "grey" of "blue" hydrogen to "green" hydrogen. The program aims at the construction of different kick-start locations for production of green hydrogen in the region before 2025, and an increase of production capacity to a gigawatt-scale by 2030.

Taking into account the unreliable production of offshore energy that is needed to produce green hydrogen, storage is an important means for flexibility, allowing a continuous offtake of this hydrogen. About 50 kilotons of storage capacity will be needed in the North Sea Port area to bridge shortages in spring and summer.In the Gent-area a Carbon Capture and Utilization (CCU) hub was created in 2018.

In 2020, a number of companies in the area have signed a joint development agreement for a first large-scale demo in Rodenhuize, called the North-C-Methanol project. It concerns a methanol demo-plant, with at its basis a 63MW hydrogen plant. The intention is to increase the hydrogen production scale in the coming years, over 300MW in 2028 to 600MW in 2030. This hydrogen will be synthesized with CO2 captured locally in other industries. The water produced in the methanol synthesis process is reused in the electrolysis process. The waste heat from the methanol synthesis process and the oxygen produced by the electrolysis process are locally reused in other industrial processes.

2. Driving the future of fuel cell and hydrogen technologies – Baudouin de Lannoy (Hydrogenics Europe / Cummins)

Cummins makes electrolysis systems and delivers them to its customers. These electrolysis systems are practically building-block containers, producing hydrogen.Different types of electrolysis systems exist, based on sometimes different technologies, each with their advantages and disadvantages. Cummins mainly produces alkaline electrolysers and PEM-electrolysers.

Whereas alkaline electrolysis can be considered the “work horse”, being a very rugged and rubust, but relatively slow and less reactive technology, Polymer Electrolyte Membrane (PEM) electrolysis can be considered the “race horse”, being very fast and reactive technology. In 2020, Cummins built the biggest PEM in the world so far in Canada. It concerns a 20MW electrolyser, managed by the Canadian TSO to aid in grid balancing. In a few seconds time, the PEM electrolyser can go from zero to maximum production capacity.

This important characteristic is one of the main advantages of PEM electrolysers, making it highly suitable for grid balancing, which requires a very reactive and dynamic response system.

3. Energy for Miles, Power for Comfort: Autonomous traction for public transport - Yves Carels (Alstom)

Alstom is best known for its trains, metros and electric buses. However, their field of expertise is much wider, as it also extends to railway systems, signalling and infrastructures, to components. Europe still has many kilometres of non-electrified railway network: about 46% of 226.000km of railway tracks is not electrified. For the rest of the world, this percentage is even higher!

Considering world-wide CO2-reduction commitments such as the Paris Agreement and the EU Green Deal, trains on these non-electrified tracks cannot continue to be powered by fossil fuels such as diesel. Electrifying these trains leaves us with two options: use of trains with on-board energy storage (OBES) or trains with a pantograph, driven by electricity coming from overhead lines (OHL).

One of the most promising solutions is an electric train with a hydrogen-powered fuel cell for onboard power generation. These trains are also equipped with a traction battery for brake energy storage. The combination of a fuel cell and a traction battery gives rise to the need for an energy management system: the heart and brains of energy supply for the train!

Today, Alstom is ready to replace diesel-fuelled trains with hydrogen-fuelled trains. They are looking out for demonstrator projects. Customers from early adopter countries are already placing orders for these hydrogen-fuelled trains.

4. Carbon neutral economy: Role of CCU methane - Daniel Marenne (Engie)

Today, electricity only accounts for 20% of the total energy consumption in Belgium. Electrification of energy consuming industries is a first option, however electrification has its limits.

On one hand, it’s impossible to fully electrify some industries and processes. On the other hand, the issue of energy storage arises: the more industries and processes are electrified, the more energy storage this will require, due to the highly volatile and uncertain production characteristics of renewables. This storage can be achieved using battery plants, having a high efficiency, however this requires a lot of infrastructure space.

Another possibility is hydrogen storage with (re)conversion to electricity when needed.

This technology requires a lot less infrastructure space than battery plants, however its overall efficiency is catastrophic, certainly when we take into account the lest step of (re)conversion towards electricity, leading to overall losses of about 65%!

Thus, it might be best not to electrify too much. Powering certain industries and processes directly on hydrogen (H2) can be the solution. However, this means that very high amounts of hydrogen will have to be imported into Europe.
Thus, it might be best not to electrify too much. Powering certain industries and processes directly on hydrogen (H2) can be the solution. However, this means that very high amounts of hydrogen will have to be imported into Europe.

There are three options for this hydrogen-import:· A pure H2-route, which is the most expensive option, as no transportation infrastructure exists yet; an ammonia route, which is a less expensive option, as the infrastructure already partially exists; a circular CO2 route, using transport of methane and/or methanol, which is the least expensive option, as the infrastructure already fully exists.

Thus, a circular CO2 route seems to be the most realistic option for hydrogen-transportation, as the existing natural gas transportation infrastructure can be used. Hence, e-methane will become a very important energy carrier in the future!

5. Fuel cells and Hydrogen joint undertaking – Bart Biebuyck (EU-FCH)

The Fuel Cells and Hydrogen Joint Undertaking (FCH JU) is "a unique public private partnership supporting research, technological development and demonstration (RTD) activities in fuel cell and hydrogen energy technologies in Europe.

Recently, FCH JU has analysed the national energy and climate plans (NECPs) of all European countries. This has led to the following EU Hydrogen Strategy :

Phase 1 (2020 – 2024)
→ Upscaling of green hydrogen production
→ Installation of at least 6GW of renewable hydrogen electrolysers in the EU, production of up to 1 million tonnes of green H2

Phase 2 (2025 – 2030)
→ Making green hydrogen an intrinsic part of the EU's energy system
→ Installation of at least 40GW of renewable hydrogen electrolysers in the EU, production of up to 10 million tonnes of green H2;

Phase 3 (2030 – …)
→ Deploy renewable hydrogen at a large scale across all hard-to-decarbonise sectors.Belgium is on the road to deployment as well.

The Flemish Government has already expressed its ambition to become a European leader in hydrogen. Starting with the installation of a 0,15MW PEM installation in Halle in 2011, the trend for these projects goes towards an increase in power (MW), thus more MW per installation, and a decreasing cost per MW. After reaching installations of 5-6MW, big players became interested.

The EU now wants to support hydrogen initiatives with subsidies. A first big “hydrogen-valley” exists in the northern part of the Netherlands (around Groninghen), where an entire hydrogen eco-system has been put in place. A new hydrogen ecosystem will be built in Mallorca, Spain: hydrogen will serve for heating, as fuel for buses, …

A next might be the development of such an eco-system in a big European city, leading the first big hydrogen-city in Europe.Cooperation on a European level is, and remains key! However, Belgium is lagging a bit with respect to its neighbouring countries. Whereas all its surrounding counties have already developed a hydrogen-strategy, Belgium still has no such hydrogen strategy today!

Credit: Fluxys - North-CCU Hub

"The Flemish Government has already expressed its ambition to become a European leader in hydrogen."

APPLICATIONS

By Kevin Snyers

This report is a summary of the fourth session on "Power to Molecule". An insight on the position of Siemens Energy and e-ammonia, Engie's strategy to be at the head of the hydrogen vectors, more details about the Fastwater project in the Antwerp region and the Van Hool fuel cell buses and their advantages.

1. Power-to-X: A closer look at e-ammonia, Siemens Energy – Zac Cesaro

Siemens Energy is currently working to make their gas turbine fully compatible for hydrogen uses before 2030. To achieve the carbonation reduction, the storage of the energy under chemical forms is one of the most efficient solution, allowing its storage for several weeks easily. This solution is needed to palliate the huge amount of hydrogen needed to fuel the gas turbine if used without transformation.

The interest of ammonia is that you need 10 times less equivalent volume as for hydrogen. Studies are carried out to reduce the NOx emissions linked to the ammonia combustion, like blend hydrogen and ammonia to increase the burning efficiency.The ammonia produced this way can be used in the existing markets (fertilizers, chemicals,…) but also in emerging markets (transport, storage,…). These markets are essential to reduce the price of the e-ammonia, which costs today thrice as much as natural gas. The electrolyser market will be the driving factor to reduce the cost of the hydrogen production, which is today the blocking point of this solution. Several demonstration plants are active in existing brown ammonia production sites.

2. Why the zero-carbon energy transition will imply the use of lots of Carbon, Engie – Dr. Jan Mertens

Engie research is focus on the development and the scaling up of the technologies that will be at the front-head tomorrow to reduce the CO2 emissions. Partnerships are done between Engie, countries and compagnies to develop and implement pilot plants in this goal. A first direction to reduce the CO2 emissions is the establishment of a circular economy of the carbon, which is possible for biogas, methanol and other energy vector used today.

A second major decision to make is to increase the electrification of the energy grid, the industries being one of the major sectors generating CO2. Finally, the power to molecules to store the energy must be developed, hydrogen being the major vector. However, to increase the volume efficiency, synthetic hydrocarbons should be preferred.These molecules must be transferred between production plants, where the renewable energies are available for green hydrogen generation to places where energy is used. E-fuels appear to be one of the best solution to convey this energy, but also to be used in transport sector (planes, trucks, boats,…). This is why e-fuels are a major point on Engie's development agenda.

3. Project van methanol als marine brandstof in de haven van Antwerpen, UGent – Pr. Sebastian Verhelst

An important sector to be focused on to reduce our CO2 emissions is the heavy transport. Improvement of the energy consumption is important, the increase of the electrification of the network but other energy vectors are equally crucial. Obviously, molecules containing hydrogen are always better energy storing vectors than hydrogen itself, from the production, containment or distribution point of view. Among the many candidates considered as hydrogen carrier, methanol appears to be one of the best solutions. It can be extracted form fossil fuels, biomass but also be synthetized using renewable energy. It is liquid at atmospheric conditions, the storage tanks are cheap, its distribution cost are low and it can be circularly used.

Recently, methanol has been considered as a good alternative to shipping fuel, leading to the Fastwater project.The project focus is given to the following points: the development of methanol compatible engines; the methanol circular economy demonstration; establishment of related regulations to support the technology. A lot of industries are looking closely to the result of those developments.

4. Fuel Cell Electric Bus: it works and it's ready!, Van Hool – Geert Van Hecke

Van Hool is one of the pioneer in fuel cell electric buses, launching the first one in 2006 in San Francisco. The autonomy of a fuel cell bus is around 1.5 times a battery bus and the charging time is between 6 and 30 times shorter.

Hydrogen is stored on the roof and used in the fuel cell and delivers the main energy required by the bus. A high voltage battery is used as buffer to insure the smooth electricity supply of the subsystems and the eventual required boost. Another advantage of the fuel cell is related to the temperature dependance of a battery bus. When the temperature drops, energy must be used to maintain the battery hot enough, decreasing the range of the bus. A fuel cell bus doesn't have this issue, which is important for regions where the temperature are often low.

The development of the fuel cell buses has been supported by the EU-FCH (see third session of "Power to Molecules") and the orders of these buses are increasing, as in Germany where the coordinated effort leads to a growing hydrogen availability.

The full reports and videos of our "Power-to-Molecules" webinars are available in the member section of our website. See you there!

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