China – The Role of Gas

An online panel event held on 21st and 22nd September 2022

Session Four: RENEWABLE GASES

Participants

Joachim von Scheele, Global Director Commercialization, Linde
Ningke Peng, Biomethane Lead, SNAM China
Jan Stambasky, Vice President, R2Gas
Jan Braun, Senior Expert Hydrogen Economy (MENA Region), Fraunhofer
Nicola Rega, Energy Director, CEFIC
Moderator: Erik Rakhou, Associate Director, Boston Consulting Group

Highlights

Russia's invasion of Ukraine has led to a complete restructuring of gas markets, making LNG an immediate solution. Europe and China are sticking to their decarbonisation goals despite challenges. European policy targets the increase of renewable gas and hydrogen imports by 2030, as well as power-to-gas.

If the current hydrogen targets are met, Europe could be the leader for hydrogen in terms of percentage of the mix replacement by 2030. In China, around 5-6% of the energy mix will be replaced by 2030.

The certification of hydrogen and other renewable gases is not yet complete, and a uniform system is lacking. Transporting hydrogen and other renewable gases is a challenge, and the question of whether it is more beneficial to transport the end product is controversial. Transport should be included in the sustainability rating of the gases.

Current situation in Europe

- By 2030, 50% of the hydrogen consumed by the industry is to be renewable. However, the question of how this will be achieved is still unclear.
- About 10% of Europe's natural gas consumption is used by the chemical industry, of which 56% is used for energy purposes, and the remaining 44% as a feedstock and for ammonia production.

Renewable gases in China

- The target for annual biomethane production in China is 10 bcm by 2025 and 20 bcm by 2030 (NDRC, 2019).
- The hydrogen plan of China's 14th Five-Year Plan contains a rather moderate target for hydrogen production of 100,000 to 200,000 tonnes by 2025.

Session One Summary

This is a summary, not a verbatim transcript, of the key points made during the online panel event.

Joachim von Scheele
Global Director Commercialization, Linde

Linde is the world largest industrial gases company, with a target to invest $1 billion every year in clean energy and renewable gases, particularly in clean hydrogen. Linde strongly supports carbon footprint certification and the transparency that comes with it.

Transporting renewable gases and hydrogen is difficult, so much of it has to be produced and used in the same place. Hydrogen is particularly difficult, while ammonia is easier to transport. Therefore, places where renewable energy is readily available will also be the places where various products will be made, e.g. ammonia, methanol, fertilisers and other renewable gases.

China is now the world's largest producer of grey hydrogen. If production were switched to green hydrogen, it would have a big impact.

From a decarbonisation perspective, there are many possible solutions that fit into the circular economy, such as gasification, biomass, municipal solid waste and plastic waste. This creates opportunities for companies in Europe and China in developing solutions to create a net-zero balance sheet.

Ningke Peng
Biomethane Lead, SNAM China

SNAM China is the second largest independent gas infrastructure company, active in gas transmission, underground storage and renewables.

Biomethane in China started with the national campaign to combat air pollution and environmental problems. One solution for this is the transition to a clean energy mix, including biomethane based on agricultural raw materials, agricultural residues, manure, livestock industry and kitchen waste. Biomethane can be part of the solution for climate change because it is already absorbing carbon during the growing season, therefore could be classified as ‘dark green’.

Green hydrogen based on renewables certainly has great potential for the future. Since the cost of renewable energies has dropped significantly and the 10-15 year cost of electrolysers are expected to drop, green hydrogen will become competitive in the mid-to-long-term.

In 2019, the National Development and Reform Commission (NDRC) set a target for annual biomethane production to reach 10 bcm by 2025 and 20 bcm by 2030.

Currently, most hydrogen production is blue and grey because it is based on chemical feedstock. However, the 14th Chinese Five-Year Plan (2021 to 2025) includes a Hydrogen Plan for the first time, with a moderate target for hydrogen production of 100,000 to 200,000 tonnes by 2025 (equivalent of 376-700 MCUM). This is the first step towards testing the whole technology for the upstream and downstream part, i.e. for fuel cells and fuel cell-based vehicles.

The potential for cooperation between the EU and China is great. In terms of biomethane and hydrogen, Europe is a step ahead of China, but the greater market potential is probably in China and China is catching up quite fast technology-wise.

ER asks: What is the total demand for natural gas in China, as compared to the 20bcm mentioned for biomethane?

NP: Nearly 400bcm per year.

Nicola Rega
Energy Director, CEFIC

CEFIC is representing the European chemical industry. With a sales volume of around €500 billion, the European chemical industry is the second largest chemical region in the world, far behind China, the world market leader. As an energy-intensive industry, the chemical industry relies on large amounts of energy, including natural gas.

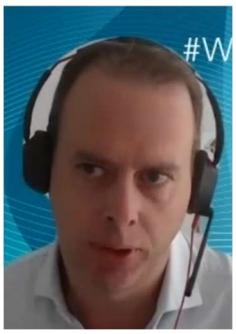
About 10% of Europe's natural gas consumption is used by the chemical industry, of which 56% is used for energy purposes, and the remaining 44% as a feedstock and for ammonia production. From a European perspective, there are clear commitments to develop legislation towards carbon neutrality by 2050.

Looking at feedstock together with energy production – industry needs the highest purity of feedstocks, because it is transformed into products. All types of molecules that contaminate it need to be removed, which creates additional costs, control measures and uncertainties.

Hydrogen, biomethane and other synthetic gases should be discussed together, because there are parallels on the questions of usage and transport. The EU's new hydrogen strategy sends a strong political signal to the market.

As far as hydrogen is concerned, the chemical industry is now the largest producer and consumer. Hydrogen is part of the production processes and is mainly produced as a by-product. The alkaline industry produces about 0.9 million tonnes of hydrogen per year as a by-product in the petrochemical industry.

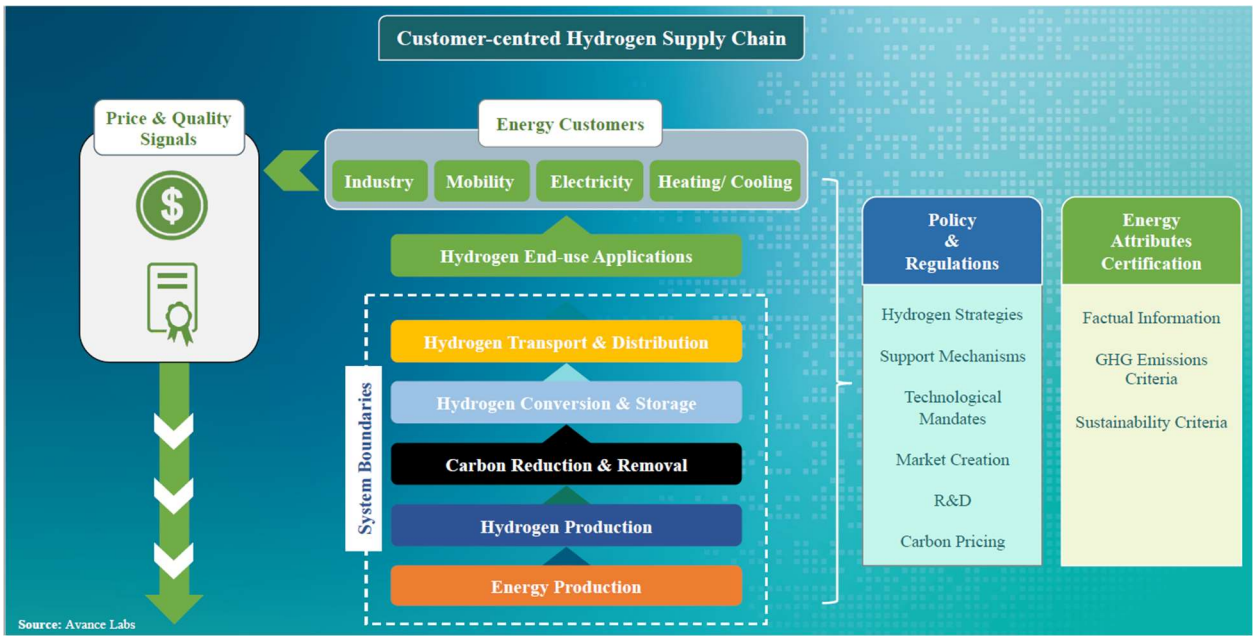
The petrochemical industry is the sector that will undergo the greatest transformation by 2050, requiring a completely different approach to dealing with molecules, new production processes, and bringing about new opportunities and challenges, such as the question on availability and transport. As far as business models for biomethane are concerned, long-term contracts, which are common for electricity from renewable energy sources, could be an option – BPAs (Biomethane purchase agreements).



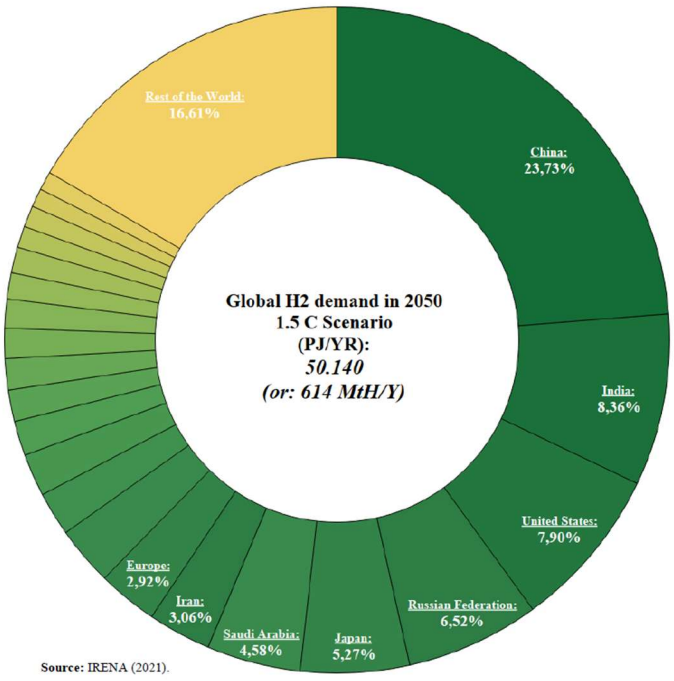
Jan Braun
Senior Expert Hydrogen Economy (MENA Region), Fraunhofer

Hydrogen will complement electricity as part of the energy transition, and electricity is an input in all hydrogen production pathways. Hydrogen will retain some of the characteristics of

LNG, but it will look very different, with value creation much closer to the end consumer. Price and quality signals will be issued to producers, who will have to adapt to the corresponding market requirements.



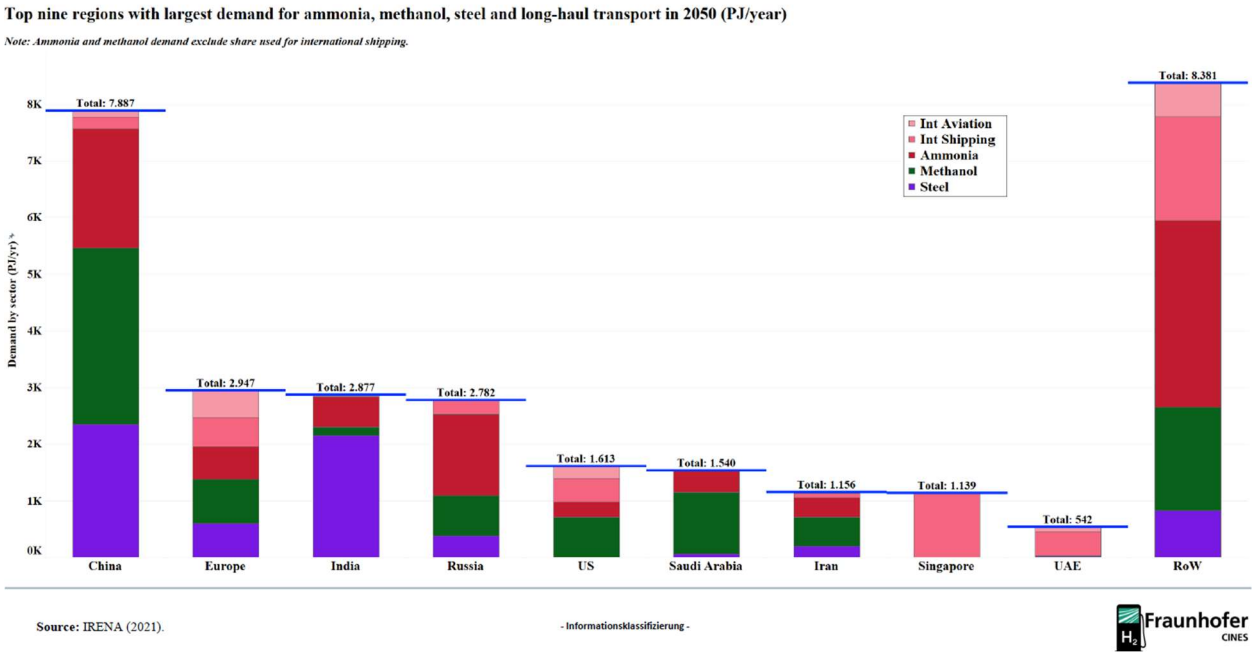
Hydrogen demand is expected to be relatively concentrated by 2050 in a 1.5 degree world, with the world's top 10 countries accounting for about two-thirds of global consumption. China drives global hydrogen demand, driven by its huge industrial sector, followed by India (steel and iron production) and the United States (transport). Europe will play a rather minor role, behind countries like Saudi Arabia and Iran.



Source: IRENA (2021).

Fraunhofer CINES

The slide shows the top 9 regions for hydrogen as a commodity.



Panel Discussion

ER asks: What are your reflections on what the other speakers have said?

JvS: To reach the targets, we need to look at where the bottlenecks are and fix them. There are some misconceptions in the headlines, for example regarding polymer electrolyte membrane (PEM) electrolysis, for which Linde has just announced a 35 MW project. The biggest constraint here is not the scale-up of electrolysis, but the cost of green electrons for production, which is 60% of the cost today. This will determine the location.

Technically, hydrogen can be used as a reducing agent in the steel industry, but raw materials suitable for direct reduction are needed. Some companies are working on the development of alternative technologies, although again time will be a limiting factor, to give just one example.

JB: Europe has huge potential for hydrogen as the world's largest import market, supported by the European Commission. Experts in the Middle East and Gulf region are concerned that Europe could quickly lose its leadership position due to its incredibly complex and inconsistent approach. The US has just passed the helpful Inflation Reduction Act and has tax credibility. Europe needs to act quickly and simplify procedures so that industries do not relocate. The introduction of the hydrogen bank by the European Commission could buy hydrogen and ensure that there is sufficient demand in Europe.

NP: Strong political support is critical for hydrogen implementation. This is reflected in the national plans of many countries. Regarding hydrogen transmission, SNAM has conducted technical and commercial tests mixing hydrogen into the natural gas infrastructure. The

results of 5% and 10% hydrogen blending in the natural gas infrastructure suggest that most of the natural gas infrastructure in Italy and probably in Europe is reliable for hydrogen blending.

There is a long-term value of hydrogen for the natural gas infrastructure. With proper refining management, the natural gas infrastructure will not only be reliable for natural gas in the current situation, but also for hydrogen in the next 30-50 years.

Green electricity could reach $20/MWh, which is competitive for the production of green hydrogen, so there is great potential here.

NR: It is crucial to define the right policy, because this determines how the market will develop. For example, the EU target for the use of renewable hydrogen in industry is 50% of total use.
The question is how do we get there? Do we transport electrons to industry to produce hydrogen on site, or do we use pipelines to transport molecules and produce hydrogen somewhere else? It's unclear which direction the market is going to develop. So there has to be flexibility. The market design has consequences for critical raw materials, as well as the type of solutions that need to be found. The chemical industry has experience in developing new solutions, new products, new components for challenges.

Regarding blending, there are studies done by the gas industry that show that blending more than 2% causes serious problems in some of the plants in the chemical industry. So a different ratio is needed and new questions arise. What happens if I sign a contract for 10% hydrogen and then only get 2% of the supply? What happens then from the contractor's point of view and from the environment's point of view? There are still lots of open issues that need to be solved.

JB asks: The question of transporting molecules versus transporting electrons - doesn't it make much more sense to focus on transporting molecules? For example, if you switch from electricity to hydrogen, you can increase the transport capacity of a 122cm pipeline from 1-2 GW to 10-20 GW.

JvS; There is a geographical shift in supply chains. It is often easier to transport the end product than hydrogen. For example, fertiliser or steel slabs produced in Namibia, that are then transported to the rolling mill in Sweden.

In the industrial gas industry, large hubs/cluster are created to supply multiple consumers instead of having long distribution networks.

NR: Molecules would certainly be easier to handle for transport. But there is also the element of time: are we able to transport the molecules from point A to point B in the given time? Besides, there are still sectors or segments of sectors that are not connected to gas pipelines, and these should also be carefully examined to see to what extent it is better to transport molecules in these situations, or whether it is better to transport electrons because the network is already there. I agree that hydrogen and industrial clusters are the first place to start developing these networks, but I disagree with focusing on imports. With COVID-19 we have seen how important value chains are.

NP: Hydrogen is a strategic option that solves the problem of storing and transmitting renewable energy. But of course there are many technical problems on the user side. There is also a need to discuss the potential cost benchmark or cost comparison between the long-term transmission of energy. Either transferring the electrons via external high voltage, electrical transmission, like China is doing, or via a gas pipeline network to transfer the molecules, like we're planning to do. Even after various studies, it is not clear whether it is more competitive to transfer molecules or electronically.

Audience Q&A

Anandita Bhada asks: How is the EU planning to decrease its dependency on China when it comes to strategic materials, which are very crucial for renewable technologies?

Sean McQuaid asks: The world reserves for silver are 20% of what we need for clean energy technologies to get to net zero. To augment the previous question, how to you think supply and demand on critical minerals will impact the renewable gas strategy?
NR: The market is very good in discovery of the cheapest option, but it disregards many other factors. That’s when we end up with a concentration of attention on where resources

are most available and the cheapest. Then policy can support building commercial relationships with other countries to diversify the sources of supply and increase security of supply. When a shortage is perceived in the market, starting with the private operators and then also at a more strategic level, then you start to think about what alternatives you can identify based on that shortage. And this is where innovation comes in. Innovation can be stimulated at the company level or from the political side, i.e. through research funding. So first a problem has to be identified, and then solutions have to be found.

JvS: From a techno-economic point of view, when we face scarcity, prices go up. And when we have continuously high prices for certain metals, then we look for new ways to replace them. For example, the battery market is showing great development in efficiency, as well as different new material-metal combinations.

ER: Technological progress is very important and has always been underestimated in the past. China has been reinvesting in critical minerals for a long time and has thus built up an advantageous position that other countries can learn from.

NP: As Adam Smith described in his book more than 200 years ago, or as Professor Jeffrey Sachs described in his book "The Age of Globalisation" this year, global business, starting from pure trade in goods, to today's technological cooperation, is very constant. Most of the problems we face today are due to globalisation and I am very sure that all solutions have to come from globalisation.

On the subject of innovation, most of the technological problems we face today are quite challenging. Finding solutions to the problems of our time can be supported by government and business. But research and development is also a form of cooperation, because it makes sense that we collect all talents, all knowledge to tackle the unknown challenges. This is why multinational companies can do research and development in several countries to organise their supply chain.

Bèr Sweering asks: Is turquoise hydrogen as a long term option not derisking the short term investments in LNG etc. that will provide a climate friendly option?

JB: Most of the discussion is usually focused on low carbon hydrogen, which is blue or it's based on renewable based hydrogen. Zero carbon hydrogen is based on methane pyrolysis with solid carbon only as a byproduct. Zero carbon hydrogen could be produced from natural gas at the resource. Saudi Arabia and the UAE have huge supplies of natural gas, which is very well suited to actually produce pyrolysis. Therefore, me and my colleague suggest to repurpose the east map pipeline for zero carbon hydrogen from Saudi Arabia and then transport is via this pipeline directly to Europe. Saudi Arabia only uses gas domestically. There’s a strong business case for blue hydrogen and methane pyrolysis hydrogen that not many people know about.

Charles Akinlabi asks: What do we see on the supply side of hydrogen and what is the role of Africa in the green and blue hydrogen supply forecast?

JB: Hydrogen will be a demand-driven market, not a supply-driven market. Certifications and standards in this area will be crucial for any very ambitious supplier, whether in Africa or in

the Gulf region. It is very important that a kilo of hydrogen in Germany is clean throughout the entire value chain. It really makes no sense to produce a kilo of hydrogen in Algeria with solar and wind energy and then transport it via a very carbon intensive process. Every supplier has to be aware of the fact that everything has to become carbon neutral.

JvS: Certifications have a great importance. I think that we should move away from the colours of hydrogen and have and understand proper certification. Hydrogen and wood fuel are a big opportunity for Africa. We don't want one dependency to turn into another dependency. On the other hand, I hope we can all work together in a nice global way. When I talk about China and the EU, I think there are so many great opportunities for cooperation, and having experience from both countries myself, I think we can do more.

NP: There is a really good opportunity for global collaboration, for example for Africa to supply some of the green hydrogen using the current gas pipeline network. I think that is a strong indication of how we can work together, how we can use the current natural gas infrastructure for green hydrogen for the hydrogen future. I think if we work together and realise the full potential of our cooperation, we can probably solve most of our problems, whether they are known, whether they are in the near future.

NR: From a European perspective, it is clear that we need cooperation with Africa in the field of hydrogen. It is essential, not only for the reasons that have already been mentioned, but also because we are neighbours and the demographic trend is clearly going in a particular direction. So we really need to make sure that it is part of a 360-degree partnership. Partnership is not just one direction, but we are trying to really work together to also support the overall development of the African region, which, as ING has already mentioned, immediately jumps into what we call the sustainability pattern that we will all enjoy.

It's about connecting the dots and seeing what is the most efficient way to move forward. We can make the leap to what is called green hydrogen. So you can just use hydrogen or also biomethane and you are on a carbon neutral path. There is a lot to do in terms of this cooperation, also in terms of lowering the cost of solutions, because we can learn a lot from each other.

Summary compiled by Helena Uhde
Produced by Energy Post