

Comment by Pier Stapersma (Senior Researcher at CIEP)

on the IRENA presentation 'the Roadmap for Hydrogen in a Geopolitical Context'

by Dolf Gielen (Director Innovation and Technology at IRENA) and

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Dear participants, Dolf, Elizabeth,

Thank you for giving me the opportunity to respond to this wonderful piece of research by IRENA. The outlook it sketches for international hydrogen trade flows are promising, for the Netherlands and for our region, Northwest Europe.

Introduction

CIEP has been involved in research on the role of clean molecules in the energy and feedstock transition for quite some time, for various reasons. I will name three.

- 1) *Growth potential of the renewable energy sector:* We have been impressed by the fast pace of change in the renewable electricity sector. But we also quickly discovered issues regarding the integration of solar and wind energy in our grids, in markets, and in the energy services for consumers. Is the absorption capacity of electricity markets sufficient for this vastly expanding sector in our economy? Can we store sufficient energy to manage variable supplies and for seasonal energy demand? How can we manage the mismatch in time between expansion of supply and the capacity of the network? How can we manage the large flows of energy in our system? It was our conviction that the renewable energy sector can really grow much further, once conversion technologies would become widely available and affordable, which can give solar and wind energy a role beyond the electricity sector.
- 2) *Types of user demand:* For some types of energy demand, electrons are unlikely to be an early solution, if at all. The aviation sector, maritime traffic, long-haul trucking, for instance, could benefit from advanced low carbon liquids and gasses. But also, we need all kinds of advanced materials, ranging from blades of wind turbines to plastics for electric vehicles, to protective coatings, etc. For feedstock for the chemical industry, electrons can play some role, but hydrogen and (circular) carbon are also needed. It is relevant to stress that Northwest Europe is home to Europe's largest petrochemical industrial clusters. Rotterdam, Amsterdam, Antwerp, the Rhine-Ruhr-area are well-known names in this regard.
- 3) *The valuable contribution of existing energy assets to the transition:* We are not building a net-zero energy system in Europe from scratch. Some see existing assets as a hurdle to change. Others recognize opportunities in these existing assets and the ability to refurbish them for low carbon energy and feedstock flows. What we can agree on, in either case, is that these assets are here. The potential value of the vast European natural gas transmission pipeline network for conversion to hydrogen transmission pipelines is

already recognized today. The European Hydrogen Backbone initiative presented a vision for a European backbone for hydrogen, covering 40.000 kilometres, of which two-third consists of repurposed existing assets.

This is the background to why we are so convinced that hydrogen and clean molecules have a role to play in the energy and feedstock transition.

Research insights

Now, I would like to share some more recent insights from CIEP research in the past few years. We were involved in several research projects, closely related to hydrogen developments. These range from a joint analysis with the IEA on hydrogen in Northwest Europe to research on the energy and feedstock transition in the Port of Rotterdam Industrial Complex. I cannot share all the insights we obtained in the few minutes I have today. I will share only some, and I will structure this as follows. Firstly, what developments do we consider relatively certain? Secondly, what do we see as relevant uncertainties? And thirdly and finally, how should we establish new value chains and supply chains?

(1) Relatively certain developments

On the supply-side: The first hydrogen shipments into Northwest Europe are expected before 2030. Volumes will initially be very modest, still. These first shipments from afar will supplement substantial regional production of green hydrogen by electrolyzers using renewable electricity, based on a step-change in terms of scale. Very ambitious 2030 CO₂-emission targets for the industry will be achieved through projects such as H-Vision and Porthos in the Netherlands, which enable industrial players to switch to low-carbon hydrogen faster, while new green flows from renewables grow in importance.

On the demand-side: While hydrogen demand in the industrial sector is firm, also hydrogen demand in the transport sector is set to grow. The role of advanced biobased fuels in our economy will increase substantially by 2030, and the refineries producing these fuels need hydrogen.

Regarding the transportation of hydrogen: In the Port of Rotterdam Industrial Complex, hydrogen pipelines will be available for consumers and producers of hydrogen. All industrial clusters will be connected by hydrogen pipelines (Hyway27) and connections with the German industry are on the drawing board. This conviction contrasts with the concerns over the timely availability of electricity transport and distribution capacities: this steers behaviour!

Coming back to the presentation by IRENA: I think these ideas fit greatly with the perspectives sketched by Dolf Gielen and Elizabeth Press. A wide range of potential suppliers of green hydrogen are on the horizon.

(2) Relatively uncertain developments

On the supply-side: Beyond 2030, what will be the balance between regional Northwest European production of hydrogen and the international flows coming into the region from more distant places?

On the demand-side: In what sectors will hydrogen be used beyond 2030? In industry, ultimately, what will be the balance between direct use of electricity, which is technically very efficient but sometimes hard to implement in practice compared to the use of hydrogen? To what degree will

hydrogen be used in the transportation sector beyond heavy-duty trucking, and what will be the role of other sustainable fuels for aviation and maritime traffic? Will hydrogen be used as a back-up for low-wind low-solar periods in the power sector (and perhaps for heating), particularly in the Northwest European winter, and how much?

Regarding the transportation of hydrogen: What hydrogen carriers will come to dominate international maritime trade. Ammonia shipments already take place. Liquid-Organic-Hydrogen-Carriers may have some advantages since they fit very well with today's liquids infrastructure in Northwest Europe. Think of all the storage and transport capacities that are used for oil and oil products today. Cryogenic hydrogen or liquified hydrogen is the third option. And how will maritime trade compare with pipeline-trade?

Coming back to the presentation by IRENA: Europe in general, and therefore also Northwest Europe, is well positioned in terms of pipeline-infrastructure. Internally, this is exemplified by the European Hydrogen Backbone initiative I referred to earlier. Externally, physical pipeline connections with traditional energy trading partners which may be refurbished.

Maps of hydrogen export potential, resemble oil/gas endowments of the past. The importing regions, namely Europe and Asia, were identified by IRENA. The Middle East and North-Africa were identified as 'surplus' regions, with the Americas, sort-of in balance. But what are the prospects for the FSU/Caspian-sea region? Moreover, can traditional suppliers of natural gas such as Norway and several North African countries find a way to benefit from their low transport cost into European markets, including their infrastructural links? Does Europe have a responsibility in managing a smooth transition for importing and exporting countries alike? After all, it is our neighbourhood, and stability is in our interest.

(3) The question of establishing new value/supply chains

How to establish supplies if there is no demand. How to create demand if there is no supply. How to develop infrastructures such as pipelines if there is no commodity. How to transport commodity if there is no infrastructure.

We are convinced, that it is here where the 'old' business activities and 'new' business will come to meet - let me explain.

Already today, the industrial clusters in Northwest Europe are major demand centres. In the IEA/CIEP publication on hydrogen in Northwest Europe, it was stated that this region represents around 5% of global hydrogen demand and 60% of European demand, while the same region is home to the largest industrial ports in Europe. Processes in the petrochemical industries require large amounts of hydrogen, which today are produced from residual (waste) gases and from natural gas. Nascent green hydrogen production can easily be integrated in these clusters, at scale, while other types of green hydrogen demand are developing.

Commercial businesses will dynamically seek the highest value applications. Business cases can be made targeting one market, but after -say- eight to fifteen years, value chains may be re-arranged adapting to the realities of the day. This highlights our idea that the energy and feedstock transition is a very dynamic process.

I'll give you a very concrete example (on how hydrogen value chains could evolve). Hydrogen demand in the mobility sector is still small. It would be very complicated to develop supply-chains *at scale*, for this nascent market. At the same time, the industrial clusters already consume large amounts hydrogen. While eliminating carbon emissions from current hydrogen production, and by integrating emerging green hydrogen flows, new green supplies can be absorbed despite the uncertain growth trajectory for emerging demand in the mobility sector.

For business cases to work, it's important to get the timing right. Through this '*sponge-effect*' in our industrial clusters, green flows can be accommodated, serving ultimately the emerging sectors.

So, in short. It could prove to be difficult to create new green hydrogen value chains *at scale* from scratch in just a short timeframe, if the context is off. The existing industrial hydrogen demand centres and their local hydrogen production provide a clear opportunity here.

Conclusion

Now, I will come back to the three convictions I shared with you in my introduction.

- (1) *The impressive growth of the global renewable energy sector:* If new supplies can be absorbed in existing industrial clusters, integration issues can be eased, providing room for further growth for the renewable energy sector. Keep in mind, no energy system is the same, they all must deal with legacies. Some of these legacies can help propel the hydrogen developments forward, others may be a temporary hindrance to the ideal combination of hydrogen, electricity, and circular carbon. We should allow markets to do their work in organising the flows and accept that intermediate steps are important to realise the full potential.
- (2) *The different types of user demand, some of which need molecules:* It is uncertain how wide exactly the adoption of hydrogen will be, yet without doubt, hydrogen is needed in some sectors, for advanced fuels, and as chemical feedstock. The industrial clusters in Northwest Europe will therefore be part of the development story. Returning to the IRENA-presentation it should be stressed that the sketched-out potential can only be realised if a widely supported certification process is developed and accepted. This will also guide the discussions about 'colours' and create a better understanding of the developments in terms of footprint, volumes, and time.
- (3) *Thirdly and finally, the valuable contribution of existing energy assets to the transition:* Assets? I am not only talking about pipelines! But also, about our energy-trade-relations, with a variety of countries in Europe's neighbourhood, including Norway, countries in the Middle East and North Africa, and beyond. We cannot afford to throw these relations overboard all too easily. We don't think it would make the transition any easier, nor would it make Europe and its neighbourhood a more stable and peaceful place. I am very much looking forward to a next report by IRENA, on the emerging hydrogen relations and the developments in regional and international hydrogen (carrier) markets. I hope it will include all the relevant consuming and producing countries and include the role of industry as a flywheel for the development of new value chains.

Thank you!