

STUDY

CROSS-BORDER HYDROGEN VALUE CHAIN IN THE BENELUX AND ITS NEIGHBOURING REGIONS

IDENTIFYING AND CONNECTING RENEWABLE HYDROGEN DEMAND AND SUPPLY VIA THE CROSS- BORDER HYDROGEN BACKBONE

February 2023

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MANAGEMENT SUMMARY

EUROPE IS ACCELERATING ITS TRANSITION TOWARDS A GREEN HYDROGEN INCLUSIVE ECONOMY. The recent geopolitical and energy market volatilities require us to drastically accelerate the clean energy transition and increase Europe's energy independence from fossil fuels. REPowerEU is the European Commission's plan to make Europe independent from Russian fossil fuels by 2030, in light of Russia's invasion of Ukraine. In this package, next to accelerating the production of renewable electricity, there is emphasis on accelerating the production of green hydrogen, which is expected to be produced from renewable electricity. Accordingly, amongst other measures, REPowerEU has announced an ambition to reach an additional 15 million tons (Mt) of renewable hydrogen on top of the 5.6 Mt foreseen under Fit for 55 plan, going beyond the targets of the EU's hydrogen strategy¹. The REPowerEU sets a target of 10 million tons of domestic renewable hydrogen production and 10 million tons of renewable hydrogen imports by 2030. Meeting these targets will require a rapid acceleration of the development of hydrogen demand market, production, infrastructure, storage facilities and import. Moreover, the supporting and facilitating policy and legislation need to be in place in no time otherwise meeting the targets cannot be realized.

THIS STUDY IS FOCUSED ON THE BENELUX COUNTRIES AND ITS NEIGHBOURING REGIONS IN FRANCE AND GERMANY (HAUTS-DE-FRANCE, GRAND EST, NORTH RHINE-WESTPHALIA, SAARLAND, RHINELAND-PALATINATE, LOWER SAXONY). The Benelux and its neighbouring regions in France and Germany are the major industrial demand centres of Europe. Some key facts about the Benelux and its neighbouring regions are,

- The Benelux and its neighbouring regions are the **centre of the European steel and chemical industry.**
- More than **20% of Europe's production capacity for methanol, olefins, ammonia and aromatics is in the Benelux.**
- More than **30% of Europe's production capacity of the aforementioned sectors and steel is in the Benelux and its neighbouring regions.**
- All sectors combined, **14% of the Europe's capacities in the hard-to-abate sectors are in the Benelux and 27% in the Benelux and neighbouring regions which is much higher than one could expect on the basis of population (7% and 17% respectively), land area (1% and 5% respectively) and GDP (10% and 19% respectively).**
- **Major ports** are located in the Benelux and its neighbouring regions which already serve as an energy transmission hub for Europe
- The Benelux and its neighbouring regions have a **very dense gas pipeline infrastructure which have a high potential to be repurposed for hydrogen transportation**

THE BENELUX COUNTRIES AND ITS NEIGHBOURING REGIONS IN FRANCE AND GERMANY WILL REMAIN EUROPE'S BEATING HYDROGEN HEART AS A CROSS-BORDER HYDROGEN DEMAND CLUSTER. Figure 1 shows the hydrogen value chain in the Benelux countries and their neighbouring regions and compares them with the rest of Europe. As shown, around 15% of the hydrogen production capacity, 67% of the import capacity,

¹ https://energy.ec.europa.eu/repowerEU-joint-european-action-more-affordable-secure-and-sustainable-energy_en

26% of the storage capacity, 24% of the hydrogen pipeline length, and between 19% and 41% of the hydrogen demand in Europe in 2030 is located in the Benelux and its neighbouring regions in comparison to Europe. The Benelux and the neighbouring regions are therefore a key hydrogen development centre for Europe.

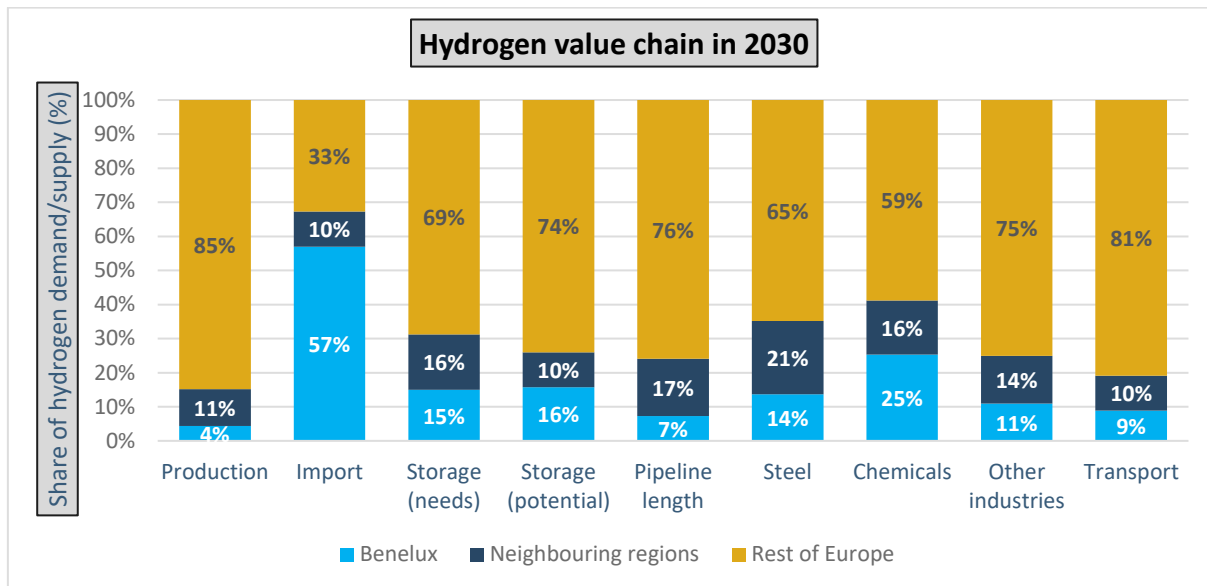


Figure 1: Quantification and shares of the hydrogen value chain in the Benelux and its neighbouring regions in 2030 (maximum scenario)

Other highlights deduced from these graphs are summarized as follows.

- **The Netherlands, Belgium and Lower Saxony foresee significant amounts of hydrogen imports** that together with the hydrogen production capacity foreseen to be deployed (based on their hydrogen strategies) **go beyond satisfying the domestic demand for hydrogen.**
- **The Netherlands and Lower Saxony** are planning to import 4 to 5 times more hydrogen than demand requires and hence they **will function as a hydrogen gateway for the neighbouring countries and regions for which their own production is not sufficient to fulfil their demand.**
- **The total amount of hydrogen imported by the Netherlands and Lower Saxony is more than sufficient to fulfil this demand in 2030.**
- **All countries and neighbouring regions foresee the development of an interconnected hydrogen pipeline system in 2030**, as can be seen in publicly available plans. For Luxembourg such public data are not yet available; the results of this study however suggest that Luxembourg has a non-negligible domestic demand potential and may offer an interesting transit potential helping to connect demand and supply centres in its neighbouring countries.
- A great amount of **undersupply of hydrogen storage capacity may exist in 2050.** It would be recommendable to develop a hydrogen storage strategy among the Benelux countries and neighbouring regions.

THE HYDROGEN PIPELINE NETWORK IN THE BENELUX AND THE NEIGHBOURING REGIONS CONNECT FOR A LARGE MAJORITY BIG PRODUCTION AND IMPORT FACILITIES WITH LARGE HYDROGEN DEMAND CLUSTERS. As part of this study, a graphical representation of the development of the hydrogen value chain is developed for 2030 and 2050. The map for 2030 is shown in Figure 2. As can be seen,

- local production of hydrogen is not all the time sufficient to cover the hydrogen demand in 2030, hence the need for hydrogen imports. **Hydrogen imports should take the perceived sense of hydrogen scarcity away;**
- **a large share of hydrogen production locations and big hydrogen demand centres are located near or at the hydrogen pipeline network;**
- **a small share of mainly small hydrogen production locations and hydrogen demand centres are not located at the hydrogen pipeline network,** some overlap indicating local projects where hydrogen demand is met by onsite electrolysis;
- for **some locations,** hydrogen demand centres do not yet have local hydrogen production, hence **other means to supply hydrogen need to be investigated;**
- for high temperature heat and transport, hydrogen demand may need to be supplied through alternative means too;
- **all the Benelux countries and neighbouring regions have a hydrogen pipeline network that is connected to at least 1 neighbouring country or regions in 2030.** This results in an interconnected hydrogen pipeline system. An exception is Luxembourg, which did not yet officially announce any target for establishment of a hydrogen pipeline system in 2030, even though there is a reasonable demand for hydrogen. It would therefore be recommendable to establish the interconnected hydrogen pipeline system already in 2030 to satisfy its swifter-than-expected rising hydrogen demand in Luxembourg and to create an extra interconnection with Saarland and Rhineland Palatinate.
- **a large part of the hydrogen pipeline network in the Benelux and the neighbouring regions is already foreseen to be established by 2030,** the only real expansion afterwards is a second east-west corridor that connect the Belgian harbour with North Rhine-Westphalia and Luxembourg.

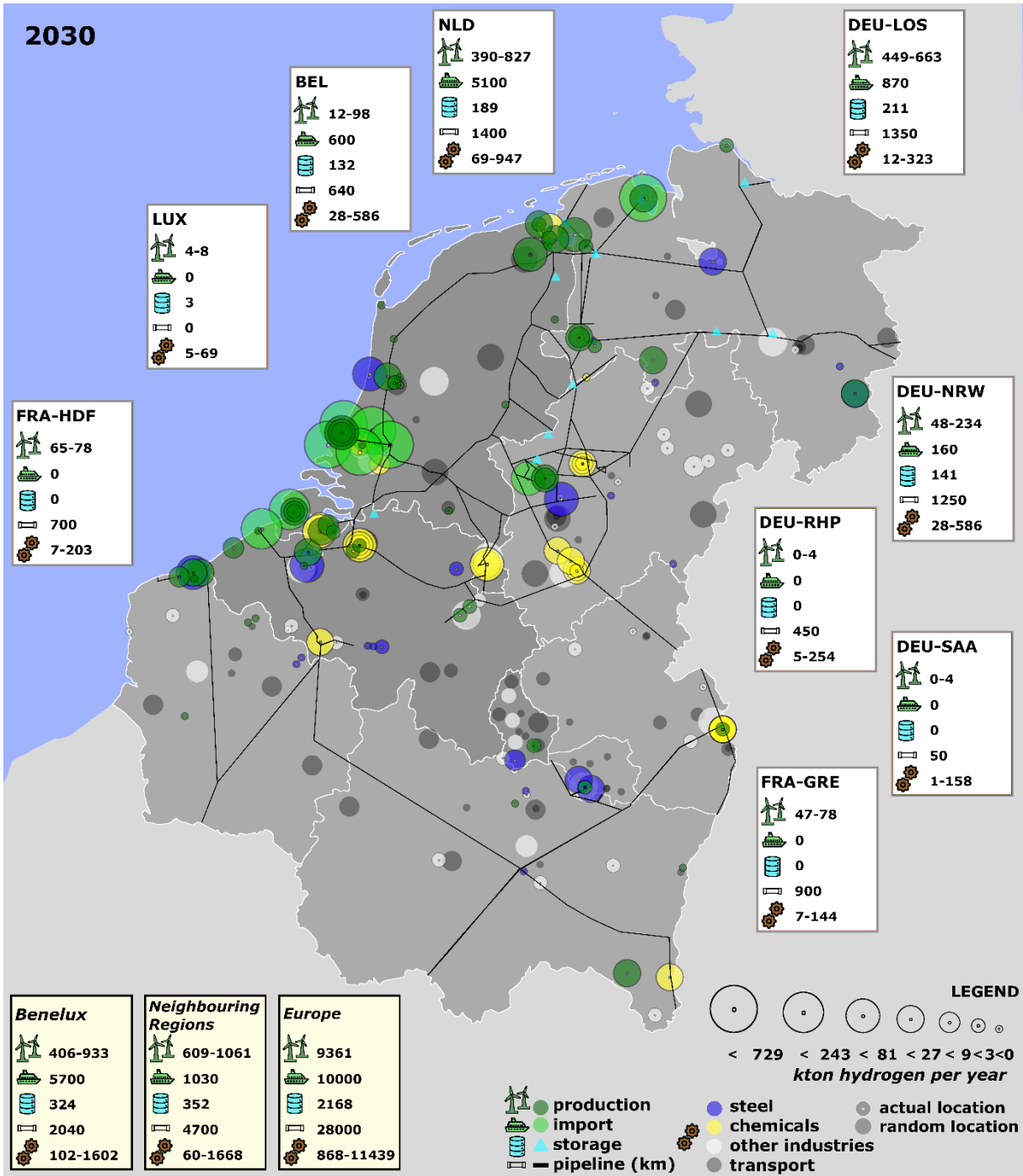


Figure 2: locations of hydrogen demand, supply, storage, pipelines in 2030 within the Benelux and its 6 neighbouring regions

During this study, we organised several workshops with main actors in the hydrogen market development from the entire value chain. During these workshops, next to verifying the collected and estimated data and strategies, the main challenges from both technology and regulatory perspective that the stakeholders are facing in the implementation of their projects and achieving their decarbonisation targets have been discussed. Stakeholders consider the **BENELUX UNION AS A KEY PLAYER IN SUPPORTING THE DEVELOPMENT OF THE REGION INTO AN OBSTACLE-FREE, CROSS-BORDER HYDROGEN HUB. A REGION THAT SERVES A KEY-PILOT LOCATION FOR EUROPE FOR CROSS-BORDER INNOVATION, DEVELOPMENT AND HARMONISATION IN HYDROGEN MARKET.**

Following the outcomes of the workshops and the discussions with stakeholders, the Benelux Secretariat and the Benelux Hydrogen Working Group, we propose **a set of recommendation for policy makers in the Benelux Union for the near-term period (2023-2026) and mid-term period (2026-2030).** These recommendations and proposed actions are meant to further strengthen the position of the Benelux and its neighbouring regions in Europe with regard to hydrogen development and to support the region in becoming the leader in the implementation of hydrogen strategies and establishment of an integrated hydrogen market in Europe.

RECOMMENDATIONS AND PROPOSED ACTIONS FOR SHORT-TERM (2023-2026) ARE AS FOLLOWS.

1. **Strengthened, collective voice towards influencing EU legislation and promoting the region** by strengthening the leading position of the Benelux-countries and neighbouring regions by leveraging their pioneering role as privileged interlocutors to shape EU legislation, with regards to large chemical and steel industries, H₂ import via seaports, H₂ backbone, transport sector, H₂ valleys; and by boosting more visibility for the Benelux and its neighbouring region in Europe and attracting more resources and funding to the region.
2. **Promoting collaboration along the hydrogen value chain** by setting up a regular dialogue and promoting institutional and regional collaboration between different public and private actors of the H₂ value chain and relevant Benelux authorities; by promoting closer collaboration, share of expertise and lessons learned and deepening the dialogue between stakeholders (TSOs of gas and electricity, HRS developers, technology developers, etc.) of the Benelux-countries and its neighbouring regions; and by ensuring the security of supply by coordinating the plannings for the electricity and H₂ infrastructure development including electrolyser plants and the repurposing of the existing gas network into dedicated hydrogen networks.
3. **Streamlined and fast-track procedures** by speeding up the permitting process to increase renewable energy and electrolyser capacity for both new and existing projects to go hand in hand with the deployment of new renewable electricity capacity; by exploring harmonisation possibilities of permitting rules; and by facilitating fast-track procedure for IP & patenting within the Benelux and its neighbouring regions.
4. **Paving the transition path** by accelerating deployment of a cross-border hydrogen backbone to facilitate hydrogen supply for hard-to-abate industries and to satisfy rising hydrogen demand; by allowing for an innovative and flexible regulatory framework for the nascent interconnected hydrogen market to accommodate the transition towards green hydrogen; and by stimulating the development of education and training programmes to have skilled labour force.
5. **Kick-start the development of an integrated hydrogen market** by harmonising system requirements, safety protocols, standards and hydrogen quality for H₂ transport and consumption; by ensuring interoperability and exchanges between certification schemes and registers and integrating and hosting a trading market for hydrogen production and import; by developing a common hydrogen storage strategy; by working with combined forces at EU level to push for the clear and tailored tax and funding schemes to avoid displacement of the investment and industrial production from EU to Asia or the US; and by encouraging a joint call of the Benelux-countries and neighbouring regions for development of the supporting schemes such as European Hydrogen Bank and H2Global, and maximising the use of other EU supporting mechanisms.
6. **Uniform approach for establishing hydrogen refuelling infrastructure** by harmonising payment systems, HRS interoperability, homologation requirements, permitting rules as well as bunkering specifications and rules for waterborne and airborne applications; and by aligning HRS implementation plan and technical specifications (quality, interfaces, protocols).

RECOMMENDATIONS AND PROPOSED ACTIONS FOR MID-TERM (2026-2030) ARE AS FOLLOWS.

1. **Advance the development of an integrated hydrogen market** by providing the means for barrier-free flow of hydrogen from production point to the end-user location through the use of the Benelux legal instruments, with extension to and alignment with the neighbouring regions by harmonising regulations for hydrogen production, import and transport; and by facilitating the market transition from a subsidy dominated system towards a competition driven system.
2. **Economic activities & education** by promoting new economic activities related to hydrogen development; and by implementing diplomas and certificates that are accepted and recognized across the Benelux region.

By working upon these actions on the Benelux level in cross-border cooperation with the neighbouring regions, the Benelux Union is able to keep its position as frontrunner in the deployment of hydrogen across all sectors and provide Europe with guidance and support on how topics of cross-border nature can affectively be tackled. In this way, the Benelux and its neighbouring regions are becoming the cross-border hydrogen hub of Europe.