ESG Strategist

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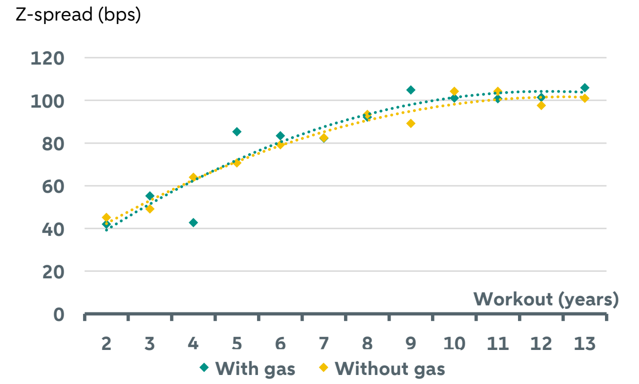
Which gas network operators are better prepared for the hydrogen transition?

- The build-up of an infrastructure for hydrogen seems to closely follow the dynamics around supply and demand for hydrogen
- Given that everything points to Europe not being able to meet its 2030 targets for hydrogen supply, also creating a hydrogen-fit transportation network seems to be running behind schedule
- This, however, reduces the risks that TSO/DSOs are prematurely repurposing or decommissioning their pipelines
- Italian network operators are expected to incur lower costs for the build-up of a hydrogen infrastructure due to (i) the country's high share of repurposed pipelines, (ii) its relatively low population density and (iii) lower share of mountainous geography
- Looking at regulation, a tariff regime for hydrogen will be in place by 2033 at the latest, but that implies that the majority of hydrogen projects could be commissioned in an unregulated environment
- Nevertheless, some countries – such as Germany - are making faster steps towards a regulatory regime for hydrogen network operators
- Still, even under a regulatory environment, without external financial support (which is the case currently), the transition to hydrogen for network operators results in a significant investment risk
- Based on the above points, we develop a "hydrogen transition readiness score" to evaluate European TSO/DSOs readiness for when the hydrogen transition comes
- We judge Enagas, REN and Gasunie to be the TSOs with a higher readiness score, while for DSOs this list is confined to Italgas, Northern Gas Networks and NorteGas

Introduction

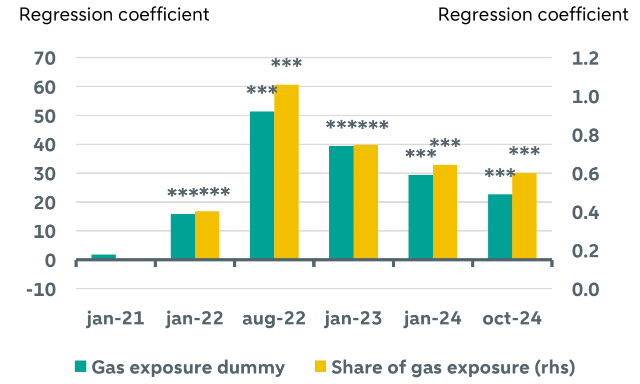
The energy crisis in 2022 shook the gas market, and had a direct or indirect impact on several utility companies. In February this year, we wrote about the existence of a 'gas premium' – an additional credit spread pick-up applied towards (regulated) gas transportation and distribution companies vis-à-vis electricity ones (see here). This gas premium has faded since then and seems to be continuing on a downward trend (see chart on the next page on the right). One of the reasons for this is how resilient the gas industry has proven to be since the crisis. Basically, the gas industry was not ultimately subject to a forced demand decrease due to lack of Russian supply, but rather to a change in the supply chain, with LNG playing an increasingly important role.

'Gas premium' almost inexistant at the moment...



Source: Bloomberg, ABN AMRO Group Economics. Note: refers to regulated utilities that have any direct exposure to gas.

...And gas importance continues a downward trend



Source: Bloomberg, ABN AMRO Group Economics. Note: *** indicates significance at a 1% level, ** indicates significance at a 5% level, * indicates significance at a 10% level and no asterisk indicates not significant.

Still, as the ambition to decarbonize the economy gains importance, different scenarios all point to an inevitable decrease in natural gas demand in the future. This supports the argument that eventually, existing infrastructure will need to be repurposed to allow for the transport of clean(er) energy. Hydrogen is among one of these energy carriers. But the transition to low-carbon gases is subject to a lot of uncertainties for transmission and distribution companies, such as:

- What are the EU plans for the development of hydrogen, including the necessary infrastructure?
- Which countries (and consequently, transmission / distribution companies) are most advanced in building a network fit for hydrogen transportation?
- What can we expect in terms of a regulation for the transport of hydrogen? This being especially relevant given that the existing regulation for the transport of natural gas allows for a stable and predictable earnings model, which highly benefits the credit profile of network issuers.

In this note, we aim to answer these questions. Our analysis moves then to discuss the potential implications for bondholders. Our piece builds on our previous note "*Hydrogen revolution seriously challenged*" (see here), which discussed the development in terms of supply and demand for hydrogen in the coming years.

The development of an European hydrogen infrastructure

Transmission and distribution of hydrogen is a service that primarily depends on sufficient hydrogen being produced and consumed. This is not the case currently, as we argued in our previous piece. As we previously highlighted, in 2022, hydrogen accounted for less than 2% of Europe's energy consumption. Furthermore, currently most of the demand is met by production close to or on site, meaning that the need for hydrogen networks have remained very limited so far. When there is need for transport, most of it is currently done via trucking (around 46%, see our previous piece). As such, as acknowledged by the EU Hydrogen Strategy (see here), the need for hydrogen infrastructure will depend on the pattern of hydrogen demand and supply, as well as transportation costs (we discuss the latter on the next section).

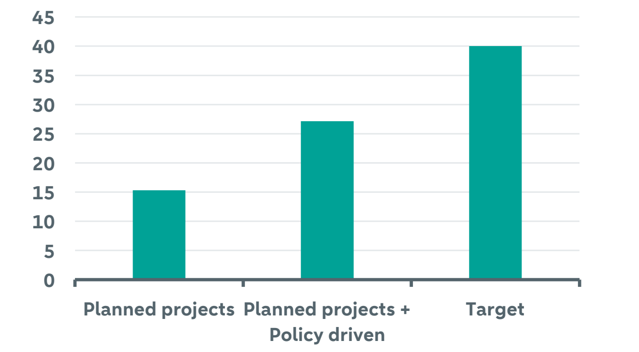
Furthermore, the roll-out of hydrogen infrastructure needs to be done in a coordinated matter (across countries but also across the value chain), while also not jeopardizing the security of natural gas supply. In other words, Transmission system operators (TSOs) and Distribution system operators (DSOs) should avoid prematurely repurposing or decommissioning their natural gas pipelines, as this could negatively affect the energy supply for end-consumers, but they should at the same time ensure that the necessary infrastructure is in place to accommodate the growing capacity for hydrogen.

Let's start by analyzing the expected build-up of hydrogen capacity in Europe.

The EU aims to have at least 40GW of hydrogen electrolyser installations, but everything points to the fact that these targets will be hard to reach (see chart on the next page on the left). In terms of individual countries, the most exposed ones to failing to meet the targets are France, Germany and Italy, while only Spain, Portugal and The Netherlands are close to meeting their 2030 targets (see chart on the next page on the right).

Europe not on track to meet its hydrogen targets...

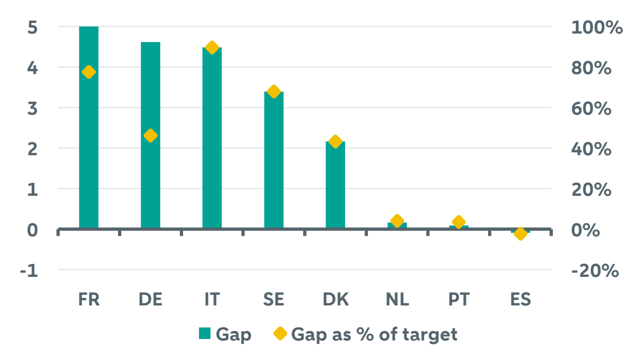
GW (in 2030)



Source: BloombergNEF, ABN AMRO Group Economics. Note: "Planned projects" indicates committed and advanced planning projects. "Policy driven" refers to additional capacity that could come online based on announced policies by countries. "Target" refers to EU's 2030 target.

... FR, DE and IT as clear laggards

Gap in GW



Source: BloombergNEF, ABN AMRO Group Economics

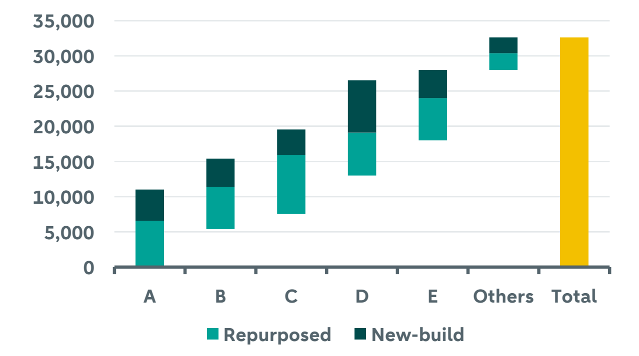
Let's now look at the plans around a hydrogen transportation network, and where do we currently stand in building such network.

The latest European Hydrogen Backbone (EHB) report developed by European TSOs (published in April this year, see here) indicates that ~32,500 km of hydrogen pipelines are expected to be in place by 2030. This enables ~15 million tonnes of hydrogen to be delivered, which is above the EU's domestic supply target of 10 million tonnes by 2030, but below the target that includes imports (20 million). Over 85% of the planned pipelines will be from the five envisioned hydrogen supply corridors (see here or the appendix). Furthermore, EHB expectations are that 52% of those pipelines will be repurposed from the existing natural gas pipeline. We note that EHB expects only around 7,500 km of projects to be operational before end of 2028, which would mean that a whopping 75% of the remaining projects expected to be live by 2030 will only be commissioned within the last couple of years of this decade. Interestingly, EHB also reports that a typical hydrogen transmission project takes around 7 years to complete, from initiation (pre-feasibility) to commissioning. That would imply that around 23,500 km of pipeline projects would need to already be in early stages at the moment. This does seem to be the case, as we highlight below.

BloombergNEF (BNEF) calculates that, besides the 1,600 km of hydrogen pipelines that are operating at the moment, a further 82 km has reached the Final Investment Decision (FID) stage and ~9,500 km of projects are still at an "early planned/announced" stage. That is significantly below the EHB's estimate of around 32,500 km of hydrogen pipelines in place by 2030 – in fact, a shortfall of nearly 19,800 km.

Target for hydrogen pipelines in 2030

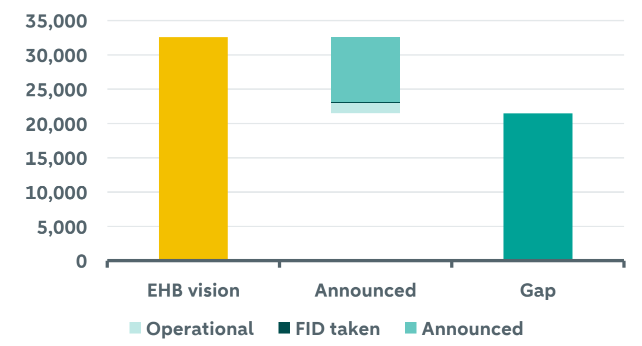
Pipeline length per corridor, in km



Source: EHB, ABN AMRO Group Economics. X-axis = corridors.

Announced hydrogen pipelines falls short of target

Pipeline length by 2030, in km



Source: BloombergNEF, ABN AMRO Group Economics

Besides the mapping of concrete projects by BNEF, the Global Energy Monitor (GEM, an independent non-profit organization focused on research on energy) also tracks the hydrogen projects that are being proposed across Europe (including for example, the ones added to the European Commission's Projects of Common Interest – or PCI – list). The GEM's overview includes therefore also projects that are expected to be commissioned beyond 2030. According to GEM's analysis, there are plans of bringing live over 32,000 km of projects in Europe, which closely aligns with the EHB for 2030. Still, GEM notices that details on some of these projects are very scarce, while some "appear to be nearly identical to older methane gas pipeline projects that were [previously] proposed for PCI status (...) begging the question as to whether “hydrogen-readiness” could be little more than a license to build gas projects”.

Another point of consideration is that the EHB’s plan of building a 32,500 km long hydrogen pipeline across Europe by 2030 takes into account the assumption that (i) there will be additional demand for hydrogen and that (ii) local hydrogen production will be insufficient to satisfy this demand, which bears the need of a pan-European transport network. Would these assumptions not materialize, it is more likely that we will be looking at the development of smaller local hydrogen networks, whose pipelines are connected to exiting industrial clusters, but not further. As such, it is ultimately the supply and demand for clean hydrogen – both in terms of volume and location - that will determine where and when additional hydrogen infrastructure is needed.

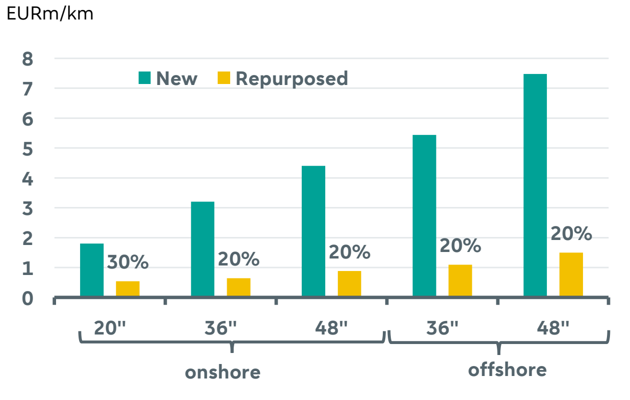
One could argue that the gap in hydrogen pipelines between announced projects (as per BNEF) and the EHB vision is just a reflection of the gap we see within hydrogen supply. As everything points to hydrogen supply and demand not building up to meet the EU’s 2030 targets, one could also say that also hydrogen infrastructure will likely lag behind the region’s expectations. While this is a negative development for the energy transition, it at least reduces the risk that TSO/DSOs are prematurely repurposing or decommissioning their pipelines, which obviously would be a negative development for their financial profile.

Which countries are better positioned for the development of a hydrogen infrastructure?

One way of evaluating which European countries are in a good position to develop a hydrogen infrastructure is by looking at the expected costs of building such network. Countries in a competitive advantage from a cost perspective are more likely to transition from natural gas to hydrogen without it imposing a significant financial burden on their local TSOs and DSOs.

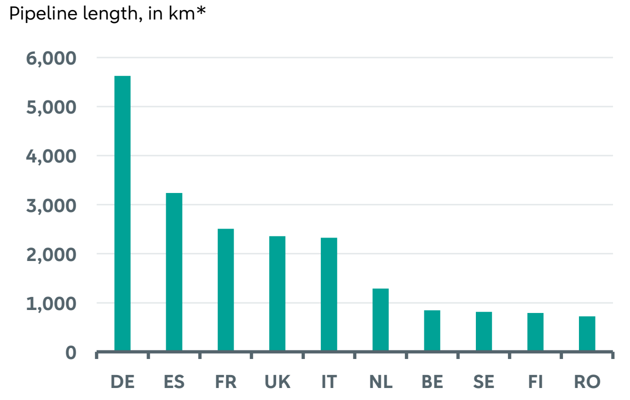
As we previously mentioned, EHB expects over half of the hydrogen pipelines by 2030 to come from existing natural gas networks repurposed for the use of hydrogen. These obviously bear a significantly lower cost than if a new hydrogen-ready pipeline needs to be built from scratch. In fact, costs are around 80% lower. In the chart below on the left we highlight the expected costs for new and repurposed hydrogen pipelines across different pipeline parameters. We note that these are European-wide estimates, but costs might differ per region / country. For example, regions with greater population density or mountainous geography might encounter higher costs. Furthermore, material and labour costs account for 70%-80% of the pipeline expenses. This implies that costs are also closely linked to changes in steel prices, energy prices, inflation, and workforce dynamics.

Repurposing a pipeline costs ca. 80% less



Source: EHB, ABN AMRO Group Economics. X-axis = pipeline parameter. Note: data labels indicate repurpose costs as % of new-build costs.

Countries with largest hydrogen network projects



Source: Global Energy Monitor (GEM), ABN AMRO Group Economics. *Note: graphs shows only top 10 countries ranked by largest pipeline length of hydrogen projects. Includes only projects expected to be commissioned by 2030.

Knowing that repurposed pipelines have a significantly lower cost than newly-built ones, it is important to consider which countries (i) are expected to develop most of the pan-European hydrogen network; and (ii) will have most of its hydrogen network in the form of new-build. These will be the countries expected to bear the highest costs for their hydrogen transport network infrastructure and will consequently be at a competitive disadvantage for the hydrogen transition.

In terms of countries, most of the pipeline is expected to be built in **Germany, Spain, France, UK and Italy** (see chart above on the right). These countries have the need to build a significant pipeline network as they are located across the five corridors outlined by the EHB (please refer to the appendix for an overview of the corridors). The corridors connect the regions with the potential to become major hydrogen production hub (this is the case for South Europe, North Africa, the North Sea, Ukraine, Scandinavia and Eastern Mediterranean) with all major demand hubs for clean hydrogen across the EU. In that regard, all corridors either go to Germany or have a direct connection to the planned German hydrogen grid, given the country's location and the size of its energy-intensive industry, which explains why the country has the ambition of developing such a large hydrogen network.

In fact, in **Germany**, the government recently announced the approval of a 9,040 km hydrogen network to be put into operation by 2032, of which 60% will be repurposed from existing natural gas pipelines. Around 5,500 km is expected to be live before 2030.

In **Spain,** the Spanish Hydrogen Backbone will consist of 3,000 km new pipelines. Although an exact share of repurposed pipelines is not available, a study has found that most of the existing natural gas infrastructure could operate with up to 20% hydrogen without requiring significant adaptation efforts. Specifically for transmission and distribution gas pipelines, the same study indicated that over 97% of the gas pipelines would be suitable for hydrogen operation (this is nearly 100% for transmission pipelines, while 76% have a *high* probability of being suitable for hydrogen use). Besides repurposed pipelines, the country will also build two new hydrogen connections: a marine pipeline route from Barcelona to Marseille by 2030 (the BarMar H2med project), as well as a new connection between Portugal and Zamora (CelZa H2med project).

In **France,** regional hydrogen networks are expected to have a length of ~700 km. France will also be a key player in connecting the hydrogen supply from the Iberian peninsula and North Africa to the demand of French and German industry clusters (through the so-called corridor B). The entire corridor includes 10,000 km of hydrogen network spanning six countries, and is expected to include 60% repurposed pipelines. Two other relevant projects in France are the HyFen and the HySow projects, with expected lengths of 1,200km and 600km, respectively. Both projects are expected to include around 40% repurposed pipelines.

In the **UK,** there is the ambition to create a ~2,500 km hydrogen network across Great Britain. However, there is not much information on how much will come from repurposed pipelines. That is because the age and post-privatisation organisational changes of UK's networks makes it hard to assess the suitability of repurposing the existing natural gas pipeline (see here). However, the ambition is to rely on repurposing "as much as possible".

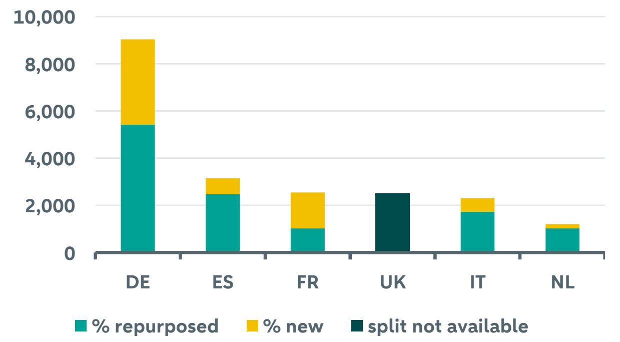
In **Italy,** the main hydrogen corridor will be the one connecting Italy, Austria and Germany. This includes around 2,300 km of internal infrastructure, of which 75% will be repurposed.

In **the Netherlands**, the government committed to building a national network (H2 Backbone) that will eventually cover a length of 1,200 km, with around 80-85% of repurposed pipelines. This also includes connections with Denmark and Germany.

The graph below on the left summarizes the aforementioned analysis. Spain, Italy and the Netherlands emerge as countries with the largest share of repurposed natural gas pipelines. These will therefore likely build a significant hydrogen pipeline without bearing too many costs for it.

NL, ES and IT have high share of repurposed pipelines

Pipeline length, in km



Source: EHB, various national sources, ABN AMRO Group Economics. Note: Germany includes also pipelines plan beyond 2030.

ES and IT also have low population density

People per km²

Source: Eurostat, ABN AMRO Group Economics. Data as of 2022.

However, as we previously noted, the EHB cost estimates are European-wide. This means that countries with greater population density or mountainous geography might encounter higher costs than the estimates we showed on page 4. That is because in densely populated areas, there are typically higher costs associated with concerns around safety, environmental impact of the project, longer planning and approval process, and so on. Looking at population density, the Netherlands emerges as a populated country, which might result in higher costs. On the other hand, Italy and Spain show a relatively low population density, which is advantageous from a cost perspective (see chart above on the right). At the same time, Spain is a mountainous country, with around half of the country covered by mountains, which also negatively impact costs. In comparison, this is around 35% for Italy and 40% for France.

As such, from a cost perspective, Italy seems to be better positioned for the build-up of a hydrogen infrastructure, with its network operators expected to incur lower costs due to (i) the country's high share of repurposed pipelines, (ii) its relatively low population density and (iii) its lower share of mountainous geography.

What about regulation?

While we determined which countries (and – as we will explore later, which transmission/distribution operators) are in a better position to transition to hydrogen without it resulting in too much of a financial burden, it is important to also explore which ones are more advanced in developing regulations around its transportation. Currently, natural gas pipelines are heavily regulated, with frameworks in place that establish caps on revenues and costs to ensure fair pricing for consumers, while providing a stable return on investment for operators. Such frameworks are therefore important for hydrogen network operators, as they reduce the associated investment risk and consequently influence the bankability of such projects.

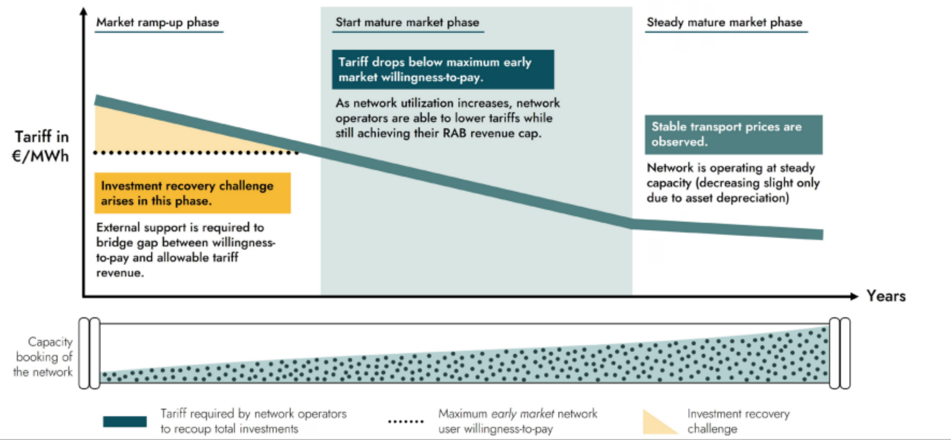
In that regard, earlier this year the European Commission (EC) adopted an EU hydrogen and gas decarbonization package, that includes both a Directive and Regulation (see here and here, respective). In the package, the EC is tasked with developing a new regulatory framework for dedicated hydrogen infrastructure, including a network code for hydrogen tariffs (which will likely mirror the existing one for natural gas). While this code is only envisaged for future years (the date is undefined at the moment), the package includes a few key dates, such as: by 1st of January 2031, national regulatory authorities (NRAs) must publish information on a tariff methodology / structure for hydrogen network operators. Furthermore, many national rules currently applicable to gas transmission operators shall also apply to hydrogen networks no later than 1st of January 2033. This includes the application of a "cost-efficient, cost-reflective and transparent tariff regime". As such, it is fair to assume that a tariff regime for hydrogen shall be in place by 2033 at the latest. Still, this would imply that the majority of hydrogen projects are expected to be already commissioned under an unregulated environment. The EHB's vision for an European Hydrogen Backbone stipulates that around 60% of the targeted hydrogen network will be in place by 2030.

Nevertheless, some countries are making faster steps towards a regulatory regime for hydrogen network operators. At present, only five EU countries have established some responsibilities to the NRAs: Germany, Lithuania, Malta, Portugal and Romania. **Germany** seems to be the most advanced, by establishing the possibility for hydrogen network operators to decide whether they want to be subject to regulation (opt-in). Once a network operator becomes regulated, it is required to provide several pieces of information (such as a development plan), but can in turn benefit from a pre-defined return on equity, which is set to be higher than for natural gas (9% for hydrogen vs. 5.07% for gas, in the case of existing assets).

Still, also transporting hydrogen under a regulatory framework may impose its challenges. The most notable one being the low production capacity for hydrogen and its resulting limited booking on the network during the market ramp-up phase, which coupled with the limited hydrogen demand could prevent network operator from generating enough revenues to cover the costs of building and operating the infrastructure in the short-term. In a 'traditional' regulatory framework, this situation would likely lead to increased tariffs in the following period(s), as a way for the operator to recoup the lost revenues. However, if these transport tariffs become too high, it could discourage end consumers from using hydrogen, further decreasing demand and ultimately creating a vicious cycle.

During this initial phase - that is, until the market matures (supply increases and transport tariffs decrease) - there is the need of external financial support, such as subsidies or financial guarantees. Without this support, transmission and distribution operators face significant investment risks as they transition to hydrogen. In other words - during this phase, these companies can no longer use the repurposed pipelines for natural gas transport, but at the same time do not generate enough profits to cover for the costs of building and operating the hydrogen infrastructure. This so-called "investment recovery challenge" is illustrated on the next page.

The investment recovery challenge for hydrogen network operators



Source: EHB 2023

Some countries are working towards potential solutions for this issue. For example, Germany is working to implement a scheme called “amortization account”, which will help to bridge the time until the hydrogen economy has evolved and there is enough demand for transportation services. In that sense, the amortization account (funded by state or state-owned financing vehicles) provides cash to TSOs during the market ramp-up, virtually “booking” the unused hydrogen capacity (read more here).

At present, however, network operators are moving forward with building a hydrogen network while bearing all the financial risk. Investments in energy infrastructure are only financially viable if there is a minimum asset utilisation, but as long as there is no large scale production of hydrogen and no significant trading activity, network asset utilisation levels will remain low. This in turn makes these investments unattractive from a risk-return perspective.

We also note that, as of now, we have discussed the transportation of hydrogen through pipelines, but as we briefly mentioned, most of it is currently carried out via trucking. As acknowledged by the European Commission’s Clean Hydrogen Alliance (see here), “It is not yet clear what the energy carrier of choice will be when it comes to transporting hydrogen over long distances. (…) and it is difficult to predict (…) what share of the market this technology will claim”. This uncertainty raises the risk that an infrastructure based on a particular hydrogen technology is being built but that might prove to have a lower market penetration (lower asset utilization) than expected. This is a risk that these companies are having to take.

Which network operators are better positioned for the hydrogen transition?

As we just mentioned, most natural gas network operators are moving forward with some transition to hydrogen while having to bear all the financial risk. Hence, another important aspect to consider when evaluating which companies are better positioned for the hydrogen transition is the access to capital. That includes companies that have a larger headroom in their credit metrics (that is, more ability to withstand higher debt levels without risking a credit rating downgrade) and that have a higher ability to undertake a potential equity raise. The latter coming from, for example, contribution from (government-owned) shareholders.

That being said, we evaluate existing European transmission and distribution gas operators’ position for the hydrogen transition according to the following criteria:

- **Location**: as we mentioned in the previous sections, countries are deemed to be more prepared for the hydrogen transition if they: (i) do not need to build such a sizeable infrastructure to accommodate the higher hydrogen flow, (ii) have a large share of its upcoming hydrogen transportation network in the form of pipelines repurposed from natural gas use; (ii) are more advanced in the hydrogen transition in terms of supply (that is, a smaller gap between expected supply and the country’s 2030 targets); and (iii) are already taking advanced steps into developing a regulatory framework for the transport and distribution of hydrogen.
- **Financial flexibility**: some companies have more room in their credit metrics to undertake upcoming investments in hydrogen, without risking a deterioration in credit profile. Hence, we look at the S&P (or Moody’s, if S&P rating is unavailable) minimum FFO/net debt ratio that the company needs to sustain without risking a rating downgrade. Additional to that, we also look at these companies’ average capex/FFO for the

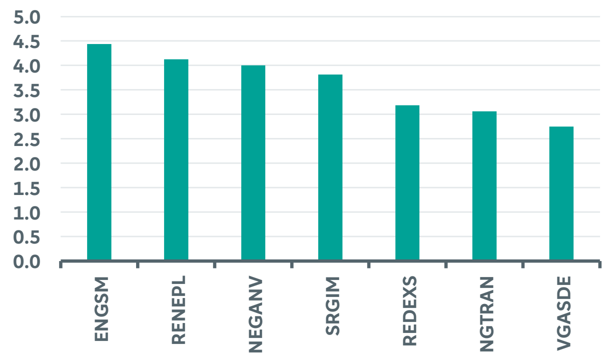
next 3 years (again, as per S&P data, or Moody's if unavailable). Our assumption is that companies with lower capex/FFO ratio have more flexibility to undertake future investment into capex as these are at moment investing less in the gas infrastructure.

- **Commitment for the hydrogen transition:** we assess whether companies have set specific targets with regards to building a hydrogen network, which we also see as a sign of their commitment to move away from gas as soon as possible.

Based on the above, we calculate the **Hydrogen Transition Readiness score** for different European TSO and DSOs that are active in the euro bond market. The score is the result of an arithmetic average across all the aforementioned criteria, in which we assign for each pillar a score between 1 and 5 (with 5 being a clear leader). As such, the higher the score, the more ready we judge this company to be for the hydrogen transition. Results are presented in the charts below.

Enagas and REN better positioned for hydrogen

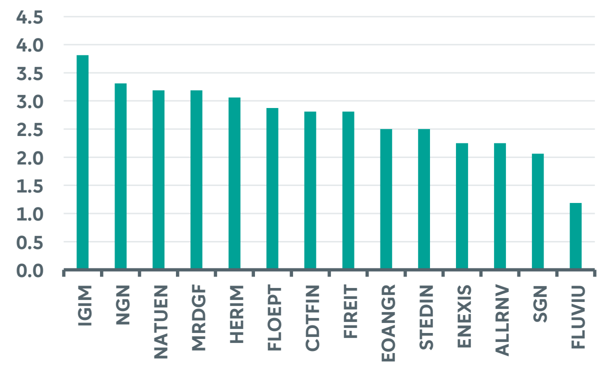
Hydrogen transition readiness score for TSOs (5 = leader; 1 = laggard)



Source: ABN AMRO Group Economics.

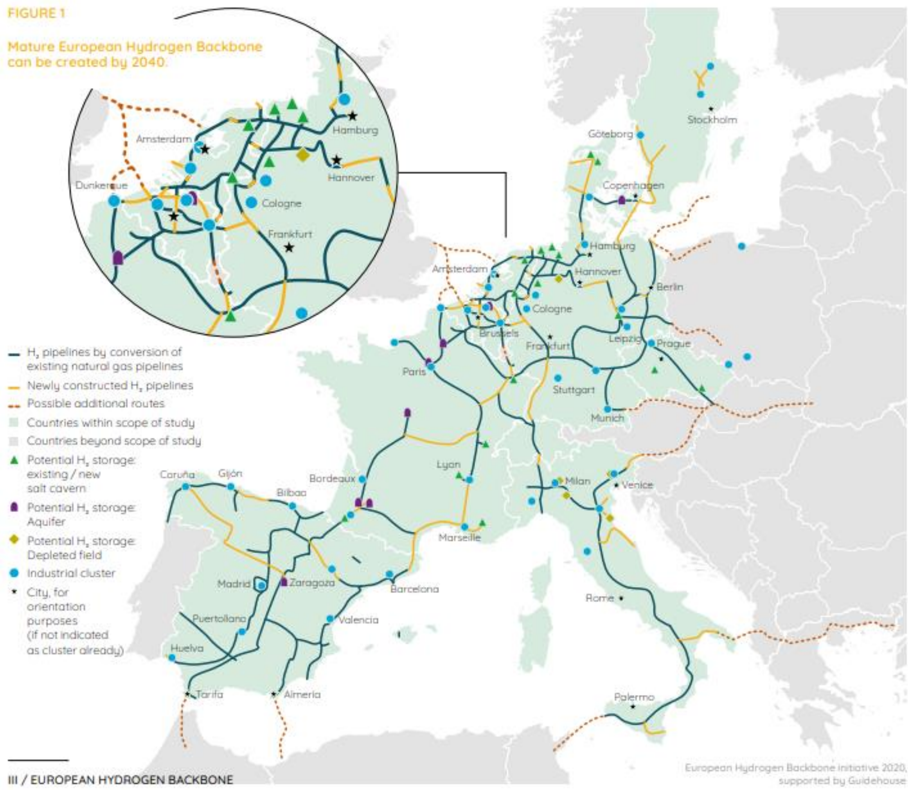
Italgas and Northern Gas well positioned for hydrogen

Hydrogen transition readiness score for DSOs (5 = leader; 1 = laggard)



Source: ABN AMRO Group Economics.

Appendix: The European hydrogen backbone corridors



Corridor A
North Africa & Southern Europe

Corridor A would transport **large quantities of cost-competitive green hydrogen potential from Tunisia and Algeria** through Italy to central Europe leveraging existing gas infrastructure.

Corridor A would decarbonise **existing industries along the route in Italy and Central Europe as well as in Germany**.

Corridor B
Southwest Europe & North Africa

Corridor B would transport **green hydrogen supply from the Iberian peninsula and North Africa**, and gain **access to underground storage sites in France** to deliver stable hydrogen supply.

Corridor B would decarbonise **regional industry and transport clusters in Portugal, Spain, France and Germany**.

Corridor C
North Sea

Corridor C includes hydrogen supply from ongoing and planned **offshore wind, blue hydrogen and large-scale integrated hydrogen projects in the North Sea**.

Corridor C would meet **demand from industrial clusters and ports in the UK, the Netherlands, Belgium and Germany**.

Corridor D
Nordic and Baltic regions

Corridor D would transport green hydrogen supply potential from **onshore and offshore wind from countries surrounding the Baltic Sea**.

Corridor D would be built around **regional networks around industrial clusters**, serving numerous new **green steel, e-fuel, fertilizer and green chemicals projects in the Nordics** as well as decarbonizing existing industry in the Nordics, Baltics, Poland and Germany along the corridor route.

Corridor E
East and South-East Europe

Corridor E would connect **high supply potential regions such as Romania, Greece, and Ukraine[1]** – leveraging vast land availability and high-capacity factors for solar and wind.

Corridor E would deliver hydrogen to **off-takers in Central Europe and Germany**.

1 While Ukraine is expected to be a hydrogen exporting region, there is significant uncertainty related to Russia's invasion of Ukraine and its impact on Ukraine's gas infrastructure and economic development.

Source: EHB

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