
RIFS DISCUSSION PAPER

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Italian Hydrogen Policy

Drivers, constraints and recent developments

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Part of a series edited by Yana Zabanova and Rainer Quitzow

Summary

Italy presents, potentially, some important comparative advantages in the emerging clean hydrogen economy. However, unlike other large EU countries, Italy has not yet issued a comprehensive strategy on hydrogen nor has it developed a coherent hydrogen diplomacy. It was only with the National Recovery and Resilience Plan, launched in the wake of the COVID-19 crisis, that Italy upgraded its measures for promoting green hydrogen and related activities. The main players in the Italian hydrogen landscape are national industrial actors, especially state-owned energy companies. This leading role can be an important asset to overcome the problems related to an industrial system otherwise composed of small and medium companies, which can find it difficult to compete with hydrogen frontrunners. Externally, Italy has supported all the European and multilateral initiatives on hydrogen, although in the EU the country is a policy-taker rather than a policy-shaper. The main focus of the Italian international approach is linked to the hydrogen hub concept, which targets the MENA region and is also supported by its national energy companies. This concept has received a further push after the beginning of the war in Ukraine. However, its practical realization is very problematic because of domestic and external challenges.

This Discussion Paper is part of a series of case studies on hydrogen strategies in European and global front-runner countries. The Discussion Paper series is being edited by **Yana Zabanova** and **Rainer Quitzow** as part of the project “Geopolitics of the Energy Transformation: Implications of an International Hydrogen Economy” (GET Hydrogen). In the context of the project, the paper has benefited from the financial support of the German Federal Foreign Office.



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1. Hydrogen in Italy: in search of a national strategy

Unlike other large European countries, as of April 2023, Italy was yet to issue a comprehensive strategy on hydrogen. At the end of 2020, the government published the first policy document – the ‘Preliminary Guidelines for a National Hydrogen Strategy’ – launching a consultation with stakeholders. However, the actual national hydrogen strategy, initially expected at the beginning of 2021, was never finalised. Despite this delay – which is not surprising for a country like Italy not used to adopting a forward-looking and comprehensive approach to energy and industrial policy issues – the development of hydrogen has become a topic more and more discussed in policy and business circles (e.g. Confindustria 2020; European House-Ambrosetti 2020). This debate has also focused on the external dimension of the Italian hydrogen policy, as the country might play the role of a ‘hub’ in the emerging international hydrogen trade by connecting North Africa with the EU market. Moreover, important national industrial actors, particularly state-owned energy companies, have recently increased their involvement in several initiatives, projects and alliances on hydrogen at home and abroad.

1.1 Overview and comparative advantages

Italy presents, potentially, some important comparative advantages in the emerging clean hydrogen economy (SNAM 2019; FCH 2020; European House-Ambrosetti 2020; Franza 2021; Giuli 2022). On the supply side, Italy could become the first EU market where green hydrogen would be the cheapest source of hydrogen. Italy ranks third in the EU in total renewable power capacity installed (excluding hydro), after Germany and Spain (IRENA 2022). According to a 2019 study by SNAM, Italy’s national gas Transmission System Operator (TSO), given the country’s access to low-cost renewable generation (particularly because of higher solar irradiation), green hydrogen will outcompete grey hydrogen by 2030, 5-10 years earlier than Germany (SNAM 2019). A study by the FCH Joint Undertaking (2020) estimates that covering Italy’s 2030 clean hydrogen demand, ranging between 113,100-571,800 tH₂, could require between 4.1 and 21 GW of dedicated renewable capacity (as of 2021 Italian renewable capacity totalled around 57 GW). Italy has the potential to develop a similar capacity. However, the slow pace in new renewable energy installations (around 1 GW per year) since the mid-2010s – when in the wake of the economic crisis the government dismantled several supporting measures – is a factor of major concern for Italy’s hydrogen ambitions (GSE 2022).

On the demand side, Italy’s use of hydrogen accounts for about 500,000 tH₂/yr (MITE 2022). This amount is mainly produced by using steam methane reformers (grey hydrogen) and is almost entirely used by the chemical and refining industry. The state-owned oil and gas company Eni is the major producer and consumer of hydrogen in Italy. According to the FCH-JU (2020) projection, however, the country has significant potential for expanding hydrogen demand in several sectors. First of all, hydrogen could play an important role in the decarbonisation of industrial energy demand, where natural gas accounts for about 35 per cent. Moreover, there are several steel plants in Italy (5 per cent of the primary steel that is produced in Europe) that could switch to hydrogen. Overall, FCH-JU sees Italian industry clean hydrogen demand oscillating between 1.13 TWh (low estimate) to 6.41 TWh

(high estimate) by 2030 (FCH-JU 2020). Further opportunity for hydrogen demand is in the heating and cooling sector, where natural gas accounts for almost 50 per cent of the final energy demand. In these sectors the FCH-JU estimates oscillated between 1.98 and 5.4 TWh by 2030. Finally, the larger opportunity for hydrogen in Italy comes from the transport sector: particularly road transport (trucks, buses and light commercial vehicles), as railway transport is electrified to a large extent and shipping does not play a major role in the economy. In the transport sector the FCH-JU (2020) estimates oscillate between 0.75 and 7.5 TWh by 2030. Currently, however, in Italy there are only five hydrogen stations for road transport: two for public transport (buses) and three for private vehicles (two of them realised thanks to a collaboration between Eni and Toyota).

Opportunities for hydrogen development in Italy also come from the presence in the country of industrial actors working on core hydrogen technologies, such as electrolyzers and fuel cells, and related equipments (European House-Ambrosetti 2020; Giuli 2022). Italy is the second EU producer of electrolysis-related core technologies (25.2 per cent of the EU total) (European House-Ambrosetti 2020). This industrial capacity, however, is not aimed at producing clean hydrogen. The Italian electrolysis-related industry should adapt to this end if intends to exploit export opportunities among partners willing to upscale clean hydrogen production. Fuel cells production is not particularly developed in Italy: €1 million in 2018 compared to €21.8 million in Germany (European House-Ambrosetti 2020). The picture is more promising with respect to some supporting technologies and equipments: mechanical, thermal, electric, and control systems. Italy is the leading EU manufacturer of thermal equipments such as evaporators, condensers, burners, and boilers for blue hydrogen. In 2018, the Italian market share was almost 25 per cent of total EU production. As for mechanical technologies (valves, pumps, compressors and pressure converters) Italy ranks second in Europe behind Germany, with a 19 per cent market share (European House-Ambrosetti 2020). However, it is worth noting that Italian companies in all these sectors are generally small size companies. This can represent a disadvantage with respect to the key competitors such as Germany, China, Japan and Korea (Giuli 2022).

Finally, thanks to its geographical position and its large gas infrastructure network, Italy might become a hydrogen hub. Italy could use the existing gas pipelines from North Africa (Algeria, Tunisia and Libya), where hydrogen can be generated from low-cost renewables and then transported to Italy and possibly Northern Europe. According to a study of SNAM (2019) importing North African green hydrogen, in the long-term, would cost 10-15 per cent less than producing hydrogen in Italy. It is worth stressing that the hydrogen hub concept is strongly supported by SNAM itself (see also below). SNAM and Eni manage the gas pipelines connecting Algeria (Transmed) and Libya (Greenstream) with Italy. SNAM's stated vision, particularly, is to 'transport entirely decarbonised gas (not only hydrogen, but also biomethane), helping to strengthen Italy's role as a European hub, with a view to exporting clean energy to Northern Europe' (SNAM 2022). The 50 per cent of the approximately €7.4 billion of SNAM's 2020-2024 business plan is for the replacement and development of pipelines that are also compatible with hydrogen transport.

BOX 1. Italy as a hydrogen hub? Lessons learned from the failure of the gas hub concept.

In the mid-2000s the concept of transforming Italy into a gas 'hub' in the Mediterranean gained popularity in policy and business circles. However, this goal was never achieved and the country remained an end market for gas export with very high prices. Several factors contributed to this failure, particularly:

- Instability in the North African region
- Instability of the Italian policy and regulatory framework
- Local opposition to energy infrastructures and length of the procedures for their authorisation
- Flat domestic gas demand

1.2 Towards a hydrogen policy: drivers and key pillars

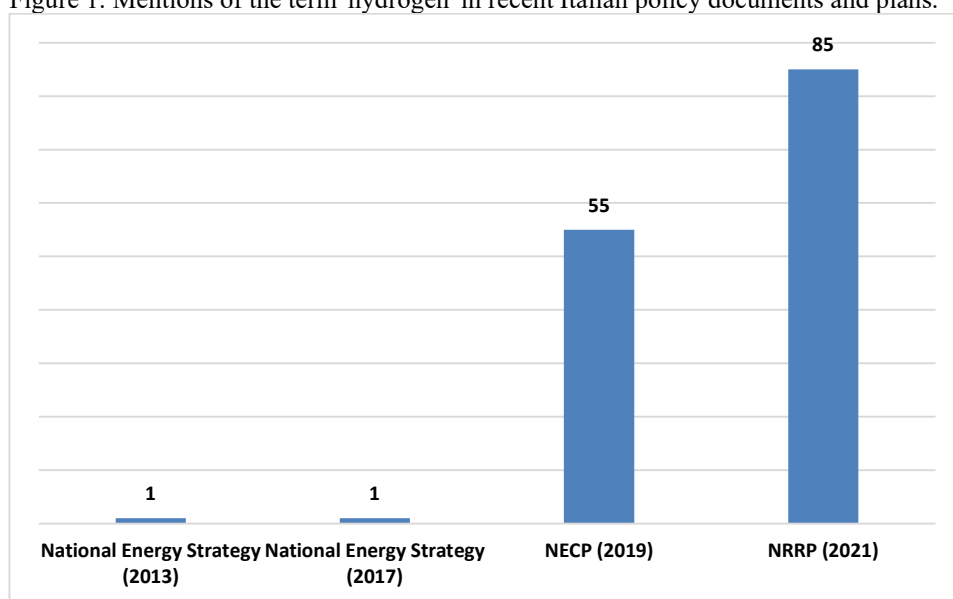
As anticipated, Italy has not yet issued a national hydrogen strategy. An embryonic policy vision on hydrogen was only drafted along with the country's 2019 National Energy and Climate Plan (NECP). Before this EU-driven document, hydrogen was basically absent from the policy debate. In the 2013 National Energy Strategy (SEN 2013), the term hydrogen was mentioned only one time with reference to the EU R&D policy, i.e. the Strategic Energy Technology Plan. Similarly, in the 2017 National Energy Strategy (a policy document of 300 pages), hydrogen was mentioned only one time in a footnote, referring to the possibility of 'imagining' a role for this source in the country's energy mix (SEN 2017). Conversely, in the 2019 NECP the term hydrogen is mentioned 55 times (NECP 2019). In this document, more importantly, the government explicitly recognised the role of hydrogen in the Italian climate and energy policy. The NECP called for exploring power-to-gas technologies to achieve flexibility and security of supply through sector integration. It also suggested that the Italian gas network could become the centrepiece of a 'hybrid' electric-gas energy system. Different possibilities were considered in the NECP, including blending as a transitional step to the development of two parallel infrastructures (on for gas and on for hydrogen). However, the NECP did not provide specific financial commitments nor did it set ambitious targets for hydrogen, mentioning only a small target in transportation: 1 per cent of the RES target for transport (amounting to about 21,132 tH₂).

In 2020, government's attention to hydrogen further increased. On November, the Italian Ministry for Economic Development issued the 'Preliminary Guidelines for the Italian Hydrogen Strategy' (MISE 2020), launching a consultation with relevant stakeholders (a consultation 'table' was also set up at the Ministry for Economic Development). The goal of the government was to finalise the national strategy on hydrogen at the beginning of 2021. However, this never happened. On January 2021 the government in charge – the so-called Conte II government – was dismissed. The newly appointed government lead by Mario Draghi (February 2021-July 2022) did not issue a national strategy on hydrogen. However, a set of new measures on hydrogen were included in the National Recovery and Resilience Plan (NRRP), transmitted by the government to the European Commission on 30 April 2021 and approved on 13 July 2021.

In the 2020 'Preliminary Guidelines for the Italian Hydrogen Strategy' the government framed hydrogen mainly as a way of matching the country's increasingly ambitious decarbonisation objectives and as a vehicle for industrial and technological development (MISE 2020). The intention of the government was to outline a roadmap with targets to establish a hydrogen economy in Italy. Hydrogen was expected to represent 2 per cent of Italy's total final energy consumption by 2030 (about 700,000 tH₂), targeting a 20 per cent share by 2050. The 2030 goal would be delivered by 5GW of electrolyser capacity, which would however cover only slightly more than half the targeted amount. This suggests a role for blue hydrogen as well (Giuli 2022), unless significant imports of green hydrogen would be commenced before 2030 (a scenario that currently is not very likely). The government foresaw that the new targets would require up to €10 billion of investments between 2020 and 2030, to which one should add investment for dedicated renewable capacity. Out of the total amount, €5-7 billion would be dedicated to production, €2-3 billion to distribution infrastructure, and €1 billion to R&D. It was expected that up to half of these investments could be supported by ad hoc national and EU resources and funds. The preliminary guidelines focused on stimulating hydrogen demand mainly in trains, heavy duty vehicles, petrochemicals and refining. Sectoral objectives, however, were only foreseen for long haul trucks: targeting 2 per cent by 2030 and up to 80 per cent by 2050. Blending hydrogen in the existing gas network was also considered as a viable strategy for stimulating the hydrogen market. According to the guidelines, with these hydrogen targets, Italy would benefit from a CO₂ reduction of 8 Mton by 2030, as well as promote the creation of 200,000 temporary jobs and 10,000 permanent jobs. The preliminary guidelines also considered the establishment of 'hydrogen valleys', as ecosystem for hydrogen innovations and technological development. Finally, the preliminary guidelines highlighted the potential role of the country as a hub for the wider European market, thanks to imports of green and blue hydrogen from North Africa.

With the 2021 NRRP the Italian hydrogen policy has been upgraded and better defined. In the NRRP the term hydrogen is mentioned 85 times, underlining a trend of growing attention to the issue by the Italian governments (Figure 1). Decarbonization and goals to obtain industrial leadership over hydrogen technologies (along the full supply chain, from production to transport, consumption and storage) have been the main drivers of this development. Moreover, with the NRRP – which is closely aligned with the 2020 EU strategy on hydrogen – the Italian government more explicitly focuses on green hydrogen, although blue hydrogen continues to be supported by important national industrial players (see below).

Figure 1. Mentions of the term 'hydrogen' in recent Italian policy documents and plans.



Sources: author's own elaboration.

According to the NRRP, the Italian hydrogen policy is based on six main pillars: i) development of flagship projects for supporting the use of hydrogen in hard-to-abate industrial sectors, starting with the steel industry; ii) promotion of 'hydrogen valleys' for industrial and technological upgrading by using brownfield industrial sites; iii) promotion of hydrogen use in the heavy transport sector – also supporting refuelling stations – and in the non-electrified railway transport (4,763 km of the Italian rail network are still served by diesel trains); iv) creation of a gigafactory for electrolyzer production; v) support for R&D activities, particularly in the area of green hydrogen production, transport and storage; vi) improvement of the regulatory framework for enhancing the hydrogen economy. Overall, the Italian NRRP allocates €3.64 billion for direct investments into hydrogen (Table 1). The largest amount of resources is allocated to the decarbonization of hard-to-abate sectors, including the shift from grey to green hydrogen (€2 billion). Green hydrogen production in brownfield industrial sites also has an important role in the NRRP (€0.50 billion): the goal of the government is to establish 10 'hydrogen valleys' by 2026 (as of September 2022, six Italian regions had plans to develop a 'Hydrogen valley' with the NRRP financial support). For the Gigafactory, the NRRP goal is to achieve 1 GW of electrolyser production capacity by 2030, whereas for road transport the target is 40 refuelling stations. In addition to these targeted measures, it is expected that the NRRP will provide indirect investments linked to the hydrogen economy in the amount of some €17 billion (MITE 2022). However, the NRRP remains quite generic on several important aspects. For instance, the NRRP considers the opportunity to offer additional financial support for 'hydrogen production and transportation' (PNRR 2021: 33). But it defers the details of these measures to the final publication of the national strategy on hydrogen, which as explained, as of April 2023, was still lacking. Despite these limits, the NRRP

has been instrumental in accelerating investments in hydrogen also by better linking national and EU-level strategies. For instance, in April 2023, the European Commission approved, under the State Aid Temporary Crisis and Transition Framework, a €450 million Italian scheme to support investments in the integrated production of renewable hydrogen and renewable electricity in brownfield industrial areas (European Commission 2023). This decision, which is in line with the RePower EU Plan and the Green Deal Investment Plan, will further help the realization of the Italian 'hydrogen valleys'.

Table 1. Hydrogen investments in the Italian NRRP.

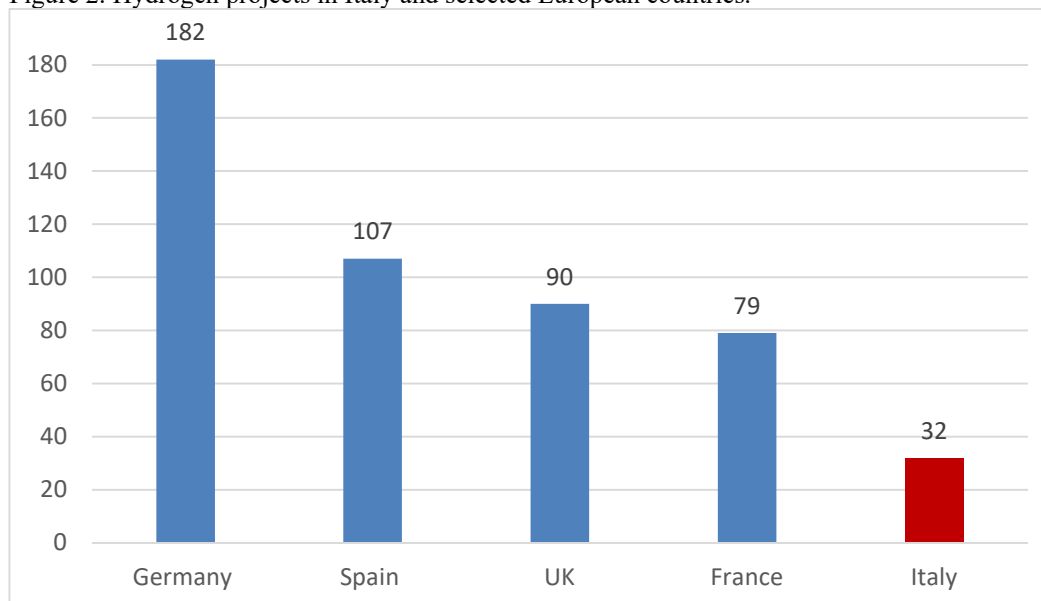
Measure	Investments (€ billion)
H2 in hard-to-abate industrial sectors	2.00
H2 production in brownfield industrial sites ('hydrogen valleys')	0.50
Gigafactory	0.45
H2 for rail transport	0.30
H2 for road transport	0.23
H2 R&D	0.16
Total	3.64

Source: PNRR (2021)

1.3 The role of national industrial actors

The interest in hydrogen economy is quite recent in Italy. The country lags well behind the other large European states in terms of hydrogen projects (Figure 2). Of the 32 Italian hydrogen projects, as of October 2022, only five were operational, one under construction, three in the demonstration phase and 23 in the 'concept' or 'feasibility study' phase.

Figure 2. Hydrogen projects in Italy and selected European countries.



Source: IEA Hydrogen Projects Database, available at: <https://www.iea.org/data-and-statistics/data-product/hydrogen-projects-database>, accessed 10 February 2023 (data as of October 2022).

Despite this gap, it is worth noting that many of these projects are promoted by important national industrial actors (i.e. state-owned energy companies), which are involved (alone or in partnership with other companies) in hydrogen development in Italy: SNAM (the Italian gas TSO); Eni (the former gas monopolist); and ENEL Green Power (ENEL is the former electricity monopolist; ENEL Green Power is the group's company that focuses on renewables). The activism of these big players in hydrogen development is in line with the Italian tradition of state-led capitalism (Schmidt 2009), which sees national champions taking the lead in emerging industrial sectors. This development might help close the gaps of an industrial system otherwise characterised by medium and small size companies. By creating partnerships with other players, these national champions link hydrogen production with relevant off-takers (e.g. energy utilities, railway operators, refineries) and support technological upgrading (see below). However, while Eni and SNAM support both blue and green hydrogen, ENEL Green Power, which is a global player in the area of renewables, only focuses on green hydrogen. If not properly managed, this divergence, in the long-run, could undermine the coherence of the Italian hydrogen policy.

SNAM, along with Eni, is the main promoter of the vision of transforming Italy into a European hydrogen hub. Along with investments for adapting its gas infrastructure to this task, SNAM is also working on developing international standard for transporting hydrogen into steel pipelines, in cooperation with RINA, an Italian company leader in international certification. Moreover, SNAM has entered into partnerships with various operators for the development of the Italian hydrogen supply chain. SNAM is working with railway operators (FS Italiane and Ferrovie Nord), traction suppliers (Alstom) and energy utilities (Eni, A2A and Hera) to develop refuelling infrastructure for hydrogen mobility in Italy. It also started a collaboration with Wolf tank Hydrogen – a company of the Austrian Wolf tank-Adisa Group dedicated to hydrogen and renewable energy – to promote hydrogen mobility through the construction of refuelling stations for cars, buses and trucks. Finally, SNAM is involved in experiments and trials for using hydrogen to decarbonise industry and power generation (BOX 2).

BOX 2. SNAM's hydrogen experiments and trials.

2019: SNAM was the first company in Europe to introduce a mix of 5% hydrogen and natural gas into its transmission network. The trial, which successfully took place in Contursi Terme, in the province of Salerno, involved the supply, for about a month, of H₂NG (hydrogen-gas mixture) to two industrial companies in the area, a pasta factory and a mineral water bottling plant. The Contursi experiment was replicated in December 2019, doubling the percentage of hydrogen to 10%.

2020: SNAM tested the world's first 'hybrid' hydrogen turbine designed for a natural gas transportation infrastructure. The turbine, produced by Baker Hughes, was fuelled up to 10% with hydrogen and it will be installed in the SNAM thrust plant in Istrana (in the province of Treviso)

2021: SNAM operated the first world's experiment for blending hydrogen (30%) with natural gas in the forging processes used in steel processing on an industrial scale (at Rho, in the province of Milan).

Source: company's website (accessed 29 August 2022).

Eni is the main Italian hydrogen producer and consumer. The company's Strategic Plan for the 2022-2025 period sets a target of producing 4 million tonnes of hydrogen per year by 2050. Eni, however, supports 'a technologically neutral approach' that combines all the available low-carbon technologies. In practice, this means that Eni supports blue hydrogen and it is investing in CO₂ carbon capture and storage (CCS) technologies and projects in Italy and abroad. In Italy, in 2022, Eni launched cooperation with Edison (an electricity utility) and Ansaldo Energia (an Italian power engineering company) to test the use of green and blue hydrogen to substitute natural gas in a power plant owned by Edison. Moreover, Eni is a member of the Hydrogen Joint Research Platform, an Italian R&D initiative

launched in 2021 in cooperation with Edison, SNAM and the Polytechnic University of Milan. Finally, on September 2022, SAIPEM – an engineering company of the Eni group – entered into a partnership with Edison and Alboran Hydrogen for developing three green hydrogen projects linked to the Puglia Region ‘hydrogen valley’ initiative.

Unlike Eni, ENEL Green Power focuses exclusively on green hydrogen. In 2021, the company began cooperation with Saras (an Italian energy company with operations in petroleum refining, marketing, transportation and power generation) to develop a green hydrogen project in Sardinia. This project provides for the use of a 20 MW electrolyser powered by renewable energy produced on site to supply green hydrogen to be used as raw material in the Saras refinery at the industrial site of Sarroch, in the province of Cagliari. In 2022, then, ENEL Green Power launched, in cooperation with Sapio (an Italian engineering company), a green hydrogen project linked to a wind power plant located in Sicily (at Carlentini). Here, ENEL Green Power also launched the ‘NextHy’ initiative, a multi-stakeholder platform for promoting R&D on green hydrogen. Finally, ENEL also takes part in the development of the Italian hydrogen valleys. For the implementation of the one in Lombardy, it entered into a partnership with Trenord – a railway transport company – for supplying green hydrogen for hydrogen-powered trains.

2. The international dimension of Italian hydrogen policy: the hub concept and beyond

Italy has not (yet) developed a coherent hydrogen diplomacy. In 2021, the Italian Ministry of Foreign Affairs funded a research project led by the Rome-based think tank ‘Istituto Affari Internazionali’ on the role of Italy in the emerging geopolitics and geoeconomics of hydrogen. However, no formal policy document has been issued by the government on the matter. The major part of the international dimension of the Italian hydrogen policy is carried on by its state-owned companies. This is not a surprise: this pattern reproduces the traditional national approach in the fossil fuel sector where the government ‘delegated’ the country’s foreign energy policy to its oil and gas companies. As illustrated, the hydrogen hub concept – that can be considered the main strategic objective of the Italian international policy on hydrogen – is especially promoted by SNAM and Eni. This concept has gained further support after the beginning of the war in Ukraine as the Italian government sees hydrogen import as a potential contribution (in the long term) to the country’s energy security. This concept is also in line with the ‘European Hydrogen Backbone’ vision promoted by the EU TSO (see below). Moreover, it has been included in the RePower EU Plan issued by the European Commission after the Russian invasion of Ukraine (European Commission 2022). At the same time, it is not yet clear what the practical implications of this move will be. Along with the hydrogen hub strategic objective, which requires developing appropriate supply chains and infrastructure, Italy and its state-owned energy companies are involved in several international initiatives on hydrogen both in the EU and outside the bloc. However, the lack of a national strategy and high government instability have hindered a more proactive stance of Italy in the EU policy-making on hydrogen. In this case as well, an important role is played by national companies, which take part in relevant EU bodies.

2.1 Political dialogue, research and innovation

All the recent Italian governments have supported the EU policies on hydrogen. In December 2020, Italy, along with other 22 EU countries and Norway, signed the manifesto for the development of a ‘European Hydrogen Technologies and Systems’ value chain supporting the launch of important projects of common European interest (IPCEIs) in the hydrogen sector. In 2022, six Italian companies were selected for the IPCEI funding (totalling about €1 billion): Ansaldo, ENEL, De Nora, Fincantieri, Alstom, Iveco. Italy is also member of the ‘Mission Innovation’ project, a global initiative of 24 countries and the European Commission. In this context, Italy joined the ‘Renewable and Clean Hydrogen Innovation Challenge’, a multinational research program, launched in June 2021, aiming to accelerate the development of the hydrogen market. Moreover, Italy is involved in the EU R&D programmes (Horizon 2020, Horizon Europe) and supports EU public-private partnerships on hydrogen, such as the ‘Fuel Cells and Hydrogen Joint Undertaking’ and its successor ‘Clean Hydrogen Partnership’¹.

¹ The Italian National Agency for New Technologies, Energy and Sustainable Development (ENEA, Agenzia nazionale per le nuove tecnologie, l’energia e lo sviluppo economico sostenibile) is involved in several EU programmes on hydrogen (e.g. H2PORTS, e-SHYIPS, CoMETHy)

At multilateral level, Italy is part of the major international organizations dealing, among other things, with hydrogen development, like the IEA and IRENA. Italy is also a member of global multilateral fora like the Clean Energy Ministerial-Hydrogen Initiative and the International Partnership for Hydrogen and Fuel Cells in the Economy, launched by the US in 2003. As for private sector initiatives, SNAM is a member of the Hydrogen Council and, along with other members, it launched in 2020 the Green Hydrogen Catapult initiative, which aims at installing 25 GW of green hydrogen production capacity by 2026. Moreover, SNAM – along with many other European TSOs – is a promoter of the ‘European Hydrogen Backbone’ initiative. This initiative, launched in 2020, supports the Italian hub concept as it envisages a North-Africa Italy Corridor for importing green hydrogen to the EU (EHB 2022). Eni is a member of the ‘European Clean Hydrogen Alliance’. The company is also involved in the ‘Hydrogen4EU’ project, which aims to analyse the contribution of hydrogen to the EU long-term decarbonization objectives. Finally, both Eni and SNAM, along with several other Italian companies and the ‘Italian Hydrogen and Fuel Cell Association’, are member of ‘Hydrogen Europe’. ‘Hydrogen Europe’ is a pan-European industry association involved in shaping the EU regulatory and market framework for hydrogen. On July 2022, a representative of SNAM was nominated in the Boards of Directors of ‘Hydrogen Europe’.

2.2. Supply chain development and overseas financing

Italian state-owned companies’ international engagement on hydrogen is very recent, starting around 2020-21. However, it has further increased after the Russian invasion of Ukraine (Italy was the second buyer of Russian gas in the EU after Germany). Paralleling domestic developments, Eni and SNAM are involved in green and blue hydrogen initiatives, whereas ENEL focuses only on green hydrogen. Moreover, Eni and SNAM are particularly active in the MENA region. These companies are exploiting their long-standing relations with oil and gas partners to establish new international hydrogen supply chains. This mirrors previous patterns when especially Eni exploited its relations in the oil sector to develop new partnerships in the natural gas sector. These new hydrogen-related initiatives are supported by the government as well. Particularly in North Africa, Algeria, Tunisia and Egypt are the main Italian partners in the perspective of realising the hydrogen hub concept. In the event of political stabilisation, Libya is (potentially) another country that could be involved in this vision.

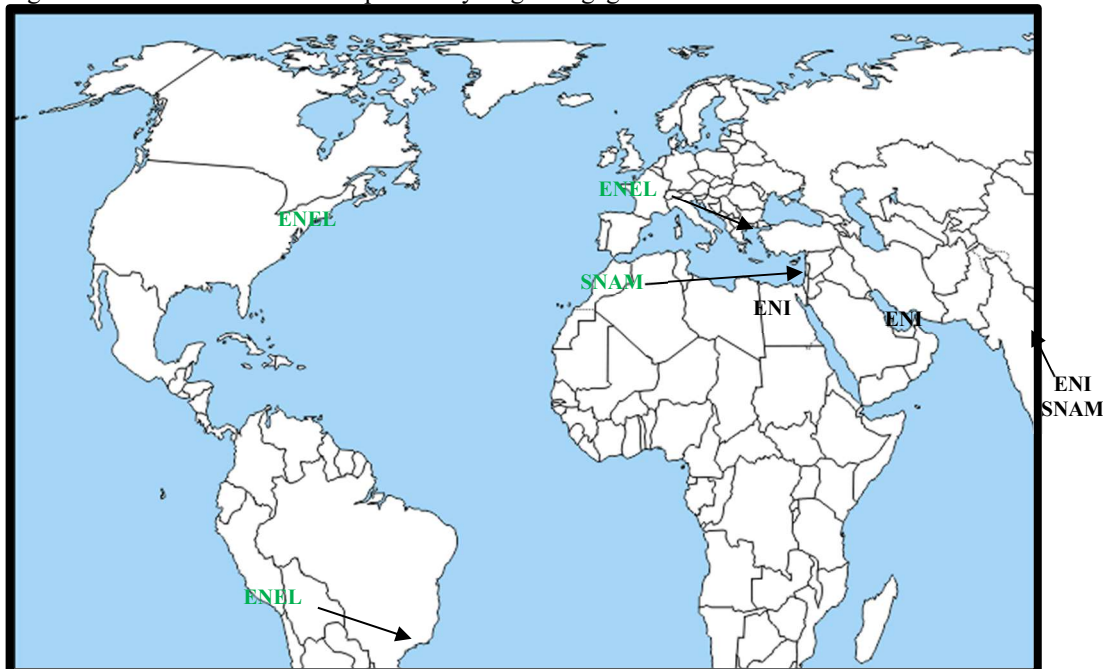
In July 2021, Eni began cooperation with the Algerian national oil and gas company, Sonatrach, for exploring Algerian hydrogen potential. In December 2021, Eni and Sonatrach signed a Memorandum of Understanding for promoting cooperation in the area of renewables, hydrogen and CCS technologies. Later on, in May 2022, after the beginning of the war in Ukraine, Eni and Sonatrach signed (supported by the Italian and Algerian governments) a new Memorandum of Understanding for extending their joint gas activities in Algeria. However, on this occasion they also decided to improve their hydrogen-related cooperation. A pilot project for developing green hydrogen has been planned by the joint venture Sonatrach-Eni GSE in the Algerian desert (at Bir Rebaa North, where Eni has already built a solar power plant). In Egypt, in July 2021, Eni signed Memorandum of Understandings with the Egyptian Electricity Holding Company and the Egyptian Natural Gas Holding Company for developing common projects on green hydrogen, blue hydrogen and CCS. In September 2021, Eni has also signed a Memorandum of Understanding with Mubadala Petroleum, a UAE company, for cooperation in the area of hydrogen and CCS. SNAM also signed, in March 2021, a Memorandum of Understanding with the Mubadala Investment company for developing common projects on hydrogen in the UAE and worldwide.

After the outbreak of the war in Ukraine, the Italian government has increased energy cooperation with Tunisia (the Transmed gas pipeline connecting Algeria and Italy crosses Tunisia). In March 2022, the Italian Ministry for Foreign Affairs launched negotiations with Tunisia on a Memorandum of Understanding for developing green hydrogen projects. In May 2022, then, SNAM likewise began talks with the Tunisian government on green hydrogen cooperation. As of April 2023, however, no formal

agreement has been signed. The growing political instability in Tunisia has hindered the Italian plans. On May 2022, SNAM also signed a Memorandum of Understanding with the Spanish company ENAGAS for evaluating the possibility of building a direct pipeline linking Spain with Italy across the Mediterranean Sea from Barcelona to Livorno. This project should allow the transportation of natural gas from Spain to Italy, and possibly to the wider EU market, bypassing France. Indeed, despite the energy crisis aggravated by the war in Ukraine, the French government has continued to oppose the so-called Midcat project (a pipeline that could allow Spanish LNG capacity to reach the European continental market). Although in the short-medium term the Barcelona-Livorno pipeline would be used for natural gas, SNAM and ENAGAS discussed the possibility (in the long-term) to use it for green hydrogen. Finally, SNAM, through its French subsidiary Teréga, is involved in the so-called H2Med project, a pipeline with the capacity to transport up to 2 million tonnes per year of green hydrogen that should connect Portugal and Spain with France by 2030. This initiative received a boost in January 2023 when Germany joined project as well.

ENEL Green Power is involved in green hydrogen projects abroad as well. While Eni and SNAM engagements are also driven by energy security considerations, ENEL activities are driven mainly by industrial and commercial objectives and target countries outside the MENA region (Figure 3). In October 2020, ENEL signed an agreement with the Chilean electricity utility AME for developing a green hydrogen project at Cabo Negro (linked to a wind power park). In December 2020, then, ENEL signed a Memorandum of Understanding with NextChem for developing green hydrogen projects in the US. Finally, in February 2021, ENEL, through its subsidiary Endesa – the major Spanish electricity utility – planned investments for almost €3 billion for green hydrogen projects in Spain.

Figure 3. Italian state-owned companies' hydrogen engagements abroad.



Sources: author's elaboration based on the information from company websites. Note: green letters correspond to green hydrogen projects and black letters to green and blue hydrogen projects.

3. Conclusions

The development of hydrogen in Italy is still in its infancy. So far, the government has not been able to issue a comprehensive strategy on the matter or to launch hydrogen diplomacy initiatives. With the adoption of the NRRP, a more robust policy on hydrogen has emerged. However, an important gap in terms of projects exists with respect to other major European countries. A similar gap exists also with regard to R&D expenditure, where Italy lags behind European frontrunners such as Germany, France and the UK (FCH-JU 2020). In both cases, some catching up is expected with the implementation of the NRRP but it is still too soon to understand whether these measures can really accelerate hydrogen development in Italy. Despite these limits, important national industrial actors are stepping up their hydrogen-related activities. Particularly, traditional state-owned energy companies like Eni, SNAM and ENEL are taking the lead. This can be an important asset to overcome the problems related to an industrial system otherwise composed of small and medium companies, which can find it difficult to compete with frontrunners. However, there is a certain difference in approach between Eni and SNAM as compared to ENEL, with the latter focused on green hydrogen and the other two (also) on blue. Additional problems in the view of developing green hydrogen in the country are related to the difficulties in expanding renewables production as well as to an underdeveloped and fragmented regulatory framework.

Externally, Italy has supported all European and multilateral initiatives on hydrogen, although in the EU the country is a policy-taker rather than a policy-shaper. Italian energy companies, however, are members of the major bodies involved in shaping hydrogen development. The main focus of the Italian international approach is linked to the hydrogen hub concept. This concept has received a further push after the beginning of the war in Ukraine. This vision, driven by energy security considerations, is supported especially by SNAM and Eni, which are also the main vehicle for the Italian external action in the MENA region. Conversely, ENEL's engagements abroad, focused on green hydrogen, are driven mainly by commercial and technological considerations. As for the natural gas hub concept (see Box 1), however, the challenges are numerous. On the one hand, the Italian hydrogen hub vision is included in the 'European Hydrogen Backbone' initiative, and the RePowerEU Plan envisions a 'potential' hydrogen corridor from North Africa to Italy (European Commission 2022: 16). But it is not clear how this plan might be translated into actual political support by other member states or the EU institutions for the Italian hydrogen hub vision. Without such support it will be difficult to implement this vision, which requires cooperation to coordinate the (potential) Italian transit's role with the role of consumers that should be played by other member states in Central and Northern Europe. Diplomatic and financial backing by the EU could help Italy to better engage those North African partners that could produce relevant volumes of green hydrogen for export. However, the past experience has shown the (very) limited impact of the EU's external action in promoting stability in the region. This political instability - as recently illustrated by the crisis in Tunisia - remains a key issue that could undermine any serious effort to develop the large and costly investment projects needed to transform the Italian hydrogen hub vision into reality.

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