The Illusion of Green Hydrogen

Sustainability of green hydrogen production and supply chain

Elena Gerebizza, ReCommon

Grafting Cities
Modena, October 19th 2023
Background and questions
Since the publication of the EU Hydrogen Strategy in 2020, research institutes and activists helped to develop a more critical view about hydrogen, exposing corporate interests and opening questions about the impacts and implications of a transition to a hydrogen economy.

A larger constituency of environmental and climate groups, researchers and experts are aware that only green hydrogen might be sustainable, if produced in hydrogen valleys for a limited, local use in hard to abate sectors.
Other uses of hydrogen, mostly pushed by the lobby of the fossil fuel industry, have been proved inefficient and most expensive if compared with other existing solutions based on renewable energy.

According to researchers and experts, led by Cambridge University professor David Cebon, “hydrogen use in buildings and for road transport is not efficient and does not make economic sense”

Repower EU and in particular the external energy strategy relaunched green hydrogen production outside of the EU, explicitly mentioning supply countries of green hydrogen and raw materials needed to decarbonize the EU
We asked to Leonardo Setti (University of Bologna) and Sofia Sandri (Centro per le comunità solari /Center for solar energy communities) to look into the hydrogen strategy guidelines developed by the Italian government and EU hydrogen strategy objectives, and explore the question:

Would a green hydrogen production and supply chain, organised to achieve these objectives, be sustainable?

"Is green hydrogen sustainable?"
From the EU Green Deal to Next Generation EU, hydrogen is the silver bullet for the decarbonization of EU economy.

Next Generation EU ➔ prioritize green hydrogen, with funding dedicated to on-site production through the development of hydrogen valleys, and the development of innovative technologies to produce it.

EU target:
1 million tons of green hydrogen per year by 2024 through 6GW of electolysis capacity
10 million tons of green hydrogen per year by 2030 ➔ 40GW of electorlysis capacity in EU (+ 40 outside) by 2050

Italian target (preliminary guidelines): 700,000 tons of green hydrogen per year by 2030, through 5GW of electolysis capacity.
Criticalities
Long distance transport is extremely energy intensive and energy inefficient

Even if we leave aside open questions about feasibility and cost of a 100% hydrogen pipeline:
- a hydrogen backbone for the transport of hydrogen for thousands of KM would be totally inefficient (3 times the energy needed for the transport of gas)

Storage is also energy intensive
- storage of liquefied hydrogen => 30% of the hydrogen's lower calorific power (PCI) is consumed
- storage of compressed hydrogen => 4-7% of the PCI is consumed

Water consumption is an issue
9 liters of water for 1 kg of hydrogen
6.3 million cubic metres of water per year to produce 700,000 tons per year by 2024 (Italian target)
If we transported it by pipeline

It would take 3 times the power of compression required for the transport of fossil gas, or 20 TWh per year.

100% of the power derived from photovoltaics in Italy

which are equal to 20 GW, almost all the derived power from photovoltaics in Italy

20 TWh per year for hydrogen → 20 GW

If we were to store it for a long time

The storage of liquid hydrogen would take place inside cryogenic storages, which require constant consumption of energy and does not eliminate the natural dispersion

0.4% of hydrogen evaporates everyday

50% of storaged hydrogen disperse after 4 months

A ship adapted to transport hydrogen of 15,000 tons by weight, would consume approx. 2000 tons of hydrogen as fuel: 100 GWh of electricity

1/7 of the transported hydrogen would be needed to power the ship

If we carried it via ship in liquid form

Considering a Europe-China return trip
Soil consumption is also an issue

Italian National Strategy aims at 5GW installed electrolysis capacity by 2024
=> may not be enough to produce 700,000 tons
=> constant and dedicated power all year long may not come from solar and wind
So, where will the energy come from?

WEC–Europe scenario of hydrogen production by 2030
=> 40 GW hydrolysis capacity could produce 2.6 million tons of hydrogen (not 10 million tons)
and only 0.8 million tons would come from renewable energy
most hydrogen produced using "additional generation from existing nuclear power plants"
1 electrolyzer of 100 MW

=> 375 megawatts of wind power (11,000 hectares!)

=> or 625 megawatts of photovoltaic power (862 hectares!)

50 electrolyzers of 100 MW each (5GW)

=> 550,000 hectares of wind farms / 5,500 km2

= Modena and Reggio Emilia districts combined!

=> or 43,100 hectares of solar farms / 431 km2

=> HYDROGEN (OR ELECTRICITY) TO BE IMPORTED FOR LONG DISTANCE / THOUSANDS OF KM FROM OUTSIDE THE EU
RePower EU and hydrogen
With RePower EU, "non-fossil", "low carbon hydrogen" are back. The external energy policy contains elements that reinforce criticalities emerged from our research:

=> Concerns that the review of RRF national plans may include pipeline retrofitting/hydrogen ready, CCS projects for blue hydrogen, etc and incentive for H2 produced through electricity generated by nuclear power plants

=> Concerns for external dimension: RePOwer EU set a target of 10 million tonnes of domestic renewable hydrogen production and 10 million tonnes of imports by 2030. This could lead to energy colonialisms and resource and energy grab in North Africa (Egypt, Tunisia, Algeria), Ukraine, SubSaharan Africa and Latin America.
A few days after RePower EU was published, 31 gas transport corporations united in the European Hydrogen Backbone Initiative presented their necessary-investment plan to implement a "shared vision" –that is their vision – for a "climate-neutral Europe, enabled by a thriving renewable and low-carbon hydrogen market”

80–130 billion investment plan structured on 5 import corridors

Italian TSO Snam is on a leading position, controlling the TransMed gas pipeline, Trans Austria Gas pipeline (TAG), the interconnection Italy-Slovenia-Hungary and the Trans Adriatic Pipeline (TAP)
The next stage of the corporate plan would imply going from 28,000 km of gas pipelines to approximately 53,000 km by 2040. 60% of those would consist of readapted gas pipelines – including underwater – fit from the start to transport also hydrogen.

"Is green hydrogen a trigger?"
Many criticalities in the current plans imply that most of the green hydrogen will be produced outside the EU and transported on long distances, making it unsustainable and a block to full electrification and to a just and sustainable transformation of EU economy.

Green hydrogen may be a trigger for public investments into retrofitting of the gas transport and distribution system (to avoid pipelines and infrastructure becoming stranded assets) for the construction of a market (not niece, local production) where hydrogen produced by nuclear or gas may also circulate.

It may serve the purpose of laying the ground for a new era of energy colonialism in the so-called "supplier countries" of a new commodity. As a minimum, this is leading to more investments into the gas infrastructure, ensuring their value beyond 2050. It leads to expansion of the gas transport: "hydrogen readiness" used to justify building new gas pipelines

=> gas lock in for EU economy
Thank you!

Elena Gerebizza
egerebizza@recommon.org