Low Carbon Hydrogen Economy in Azerbaijan

European Bank for Reconstruction and Development

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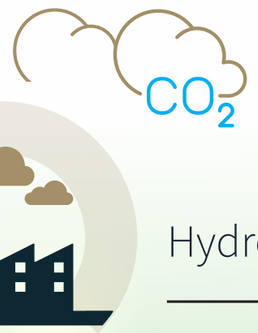
THE COLOURS OF HYDROGEN

Grey Hydrogen

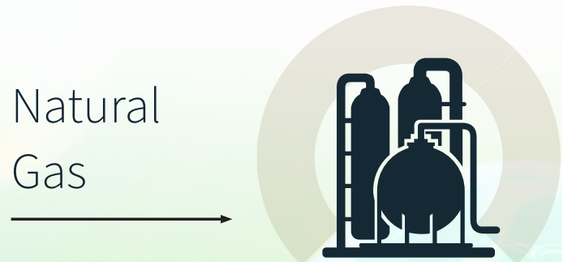
Steam methane reforming (SMR) of natural gas



- Fossil fuels are used as a feedstock and chemically converted to yield hydrogen
- High emissions and uses non - renewable resource

Blue Hydrogen

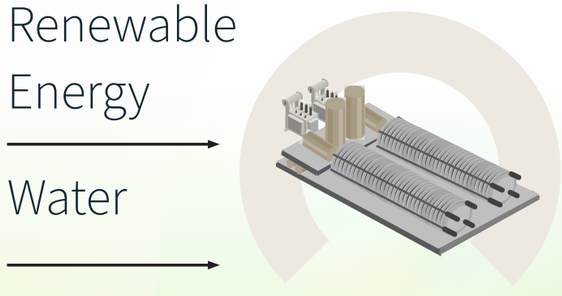
SMR with carbon capture and storage (CCS)



- Similar to grey hydrogen but with capture and storage of CO_2 emissions
- Low Scope 1 and 2 emissions but still uses non-renewable resource

Green Hydrogen

Water Electrolysis



- Uses electrolysis (separation of water into H_2 and O_2) to form hydrogen
- Minimal Scope 1 and 2 emissions

Azerbaijan's strengths in developing a low carbon hydrogen economy

Existing hydrogen derivatives market, both ammonia and methanol, provide a focal point for green and blue hydrogen production

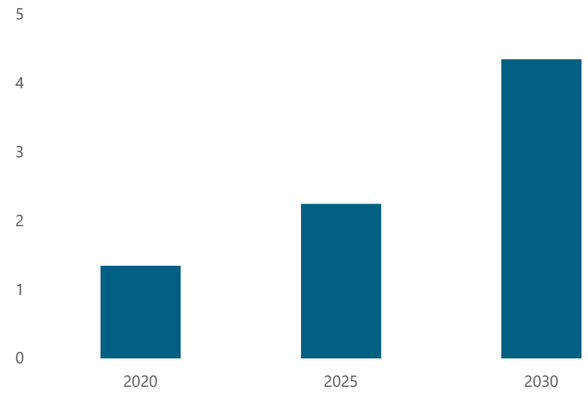
With established refining, ammonia, and methanol markets and extensive natural gas distribution systems which could be converted to hydrogen, Azerbaijan has great potential for low carbon hydrogen demand. Hydrogen could help to decarbonise these industries while utilising existing expertise in ammonia and methanol to implement blue and green hydrogen production.

Azerbaijan's access to natural gas reserves provide great opportunity to develop blue hydrogen projects

With excellent renewable resources near to the Caspian Sea and eastern Azerbaijan along with direct access to natural gas reserves in Shah Deniz field, the country is well positioned to develop both green and blue hydrogen. Blue hydrogen implementation will need to involve investigations into CO_2 storage opportunities in depleted gas fields and upstream emissions. Additionally, existing natural gas infrastructure such as the Southern Gas Corridor (SGC) will potentially allow hydrogen blending into the gas network for export.

Natural gas field in Caspian Sea, Azerbaijan

Great quality renewable resources and high expansion potential



Azerbaijan renewable capacity expansion ambitions (gigawatts)

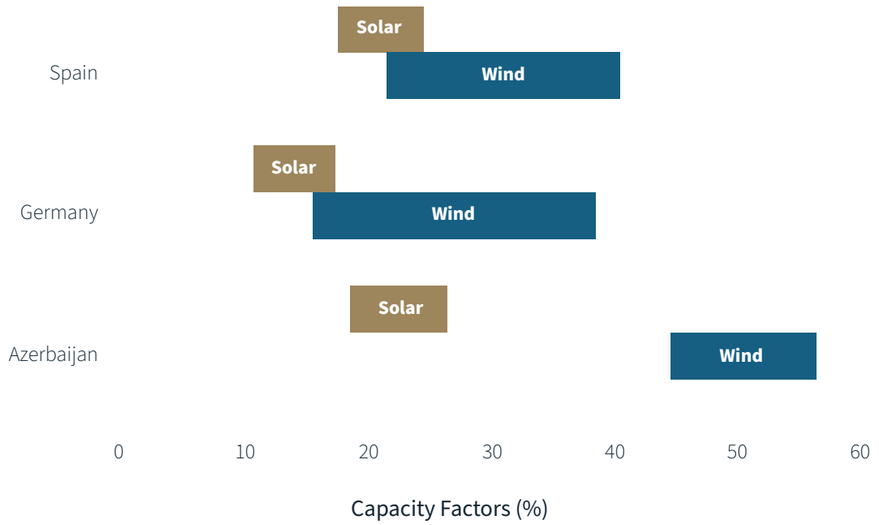
Azerbaijan has high quality wind and solar resources, with 1305 MW of renewable capacity installed as of 2020. Growth targets include 30% renewables capacity by 2030. The main renewable energy currently in place in Azerbaijan is hydropower though there is high wind potential along the Caspian Sea and offshore and high solar potential in east Azerbaijan.

The low cost and high potential availability of renewable electricity will boost the establishment of a low carbon hydrogen economy in Azerbaijan.

AZERBAIJAN'S LOW CARBON HYDROGEN PRODUCTION COMPETITIVENESS

Green hydrogen production costs

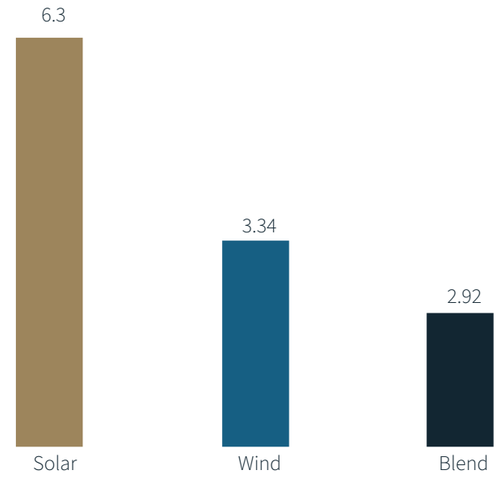
The levelised cost of hydrogen (LCOH) of green hydrogen is highly sensitive to capacity factor. When the capacity factor decreases the LCOH increases, especially apparent with solar where the low capacity factors lead to low utilisation of high capital electrolyser modules and thus higher LCOH. Green hydrogen produced in Azerbaijan is likely to be cheaper than green hydrogen produced elsewhere in Europe if cost efficient transportation measures such as re-purposed natural gas pipelines are utilised. Due to intermittency of renewables, a blend of wind and solar resources, maximising the load factor, achieves a LCOH of around 2.92 €/kg, which should decrease over time.



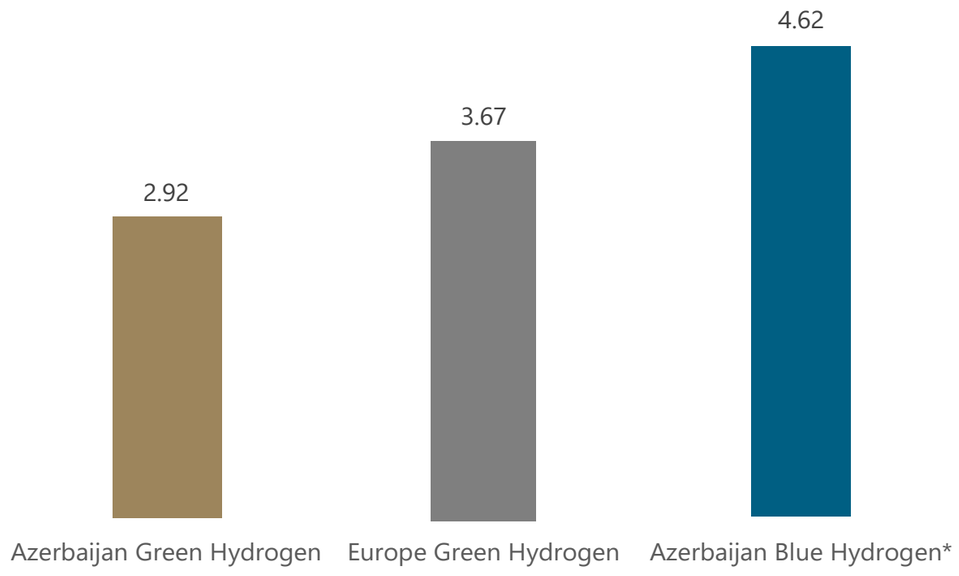
Renewable resource capacity factors compared

Blue hydrogen production costs

The blue hydrogen market has potential in Azerbaijan due to natural gas reserves which may enable costs to be lower than the equivalent production in Europe and to green hydrogen. However, uncertainties including future natural gas prices, and CO_2 transportation and sequestration costs as well as storage sites should be considered. Additionally, though domestic gas price is low, high international gas prices of 60 EUR/MWh (HHV, higher heating value basis) could make the use of domestic natural gas for blue hydrogen economically unfavourable as it would displace natural gas available for export. Blue hydrogen will also need additional investment to meet regulations and upstream fugitive emissions will need to be mitigated.



Green Hydrogen LCOH in EUR/kg (2030)



*LCOH in EUR/kg (2030) *based on future international gas price of 60 EUR/MWh (HHV)*

How low carbon hydrogen can be used in Azerbaijan and potential for exporting

Ammonia and methanol production decarbonisation

Green ammonia and methanol for low carbon fuels

Existing ammonia and methanol plants in Azerbaijan form a key option for future use of hydrogen. The existing facilities can either incorporate green or blue hydrogen to produce methanol and ammonia to decarbonise existing facilities. Ammonia and methanol can be used as low carbon fuels though it will be important to evaluate the CO_2 balance of those plants and ensure that biogenic feedstocks are used.

Hydrogen use in domestic market

Expansion in 2040 to industrial fuels and possible grid balancing

In medium and long-term, low carbon hydrogen can be used in the wider domestic market for fuel in transport, grid balancing and industry use. Azerbaijan is a major transport hub between Europe, Central Asia and China and there is potential to use hydrogen and derived fuels for decarbonisation of heavy transport. However, synthetic methane will struggle to be competitive with compressed natural gas (CNG) use for city buses.

1.6 MT
Yearly demand of grey ammonia

290 kT
Green hydrogen needed per year to switch to green ammonia

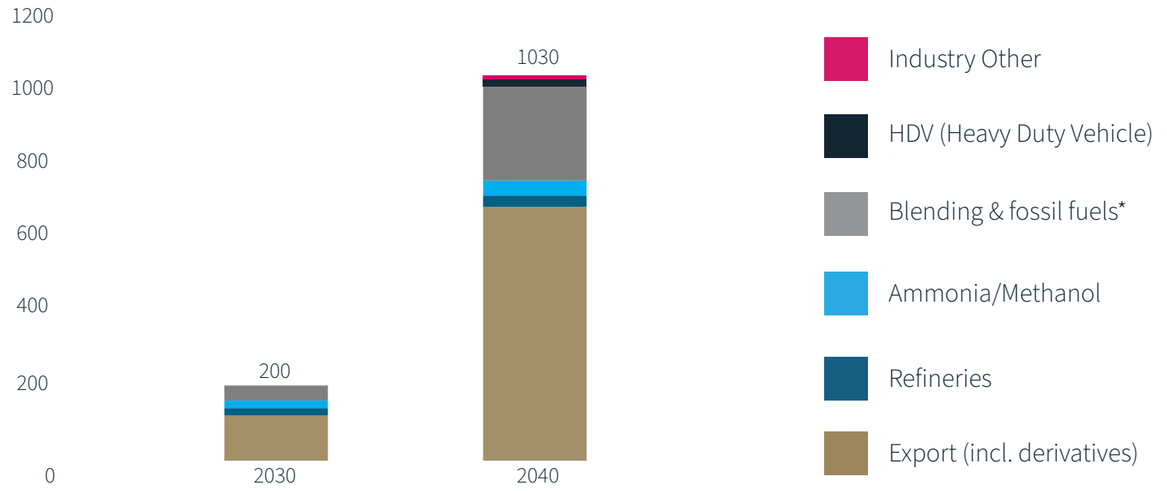
Export of green hydrogen and synthetic liquid fuels

Due to the existing export of natural gas from the Shah Deniz field to Europe through the SGC natural gas pipeline system, export opportunities via blending into the existing pipelines are substantial. Agreeing the commercial and contractual arrangements to allow blending of hydrogen and natural gas in the SGC pipeline system for export to Europe will be important along with ensuring that international standards are met. High transmission fees for transport of hydrogen through the SGC could make the delivered cost in Europe uncompetitive.

Re-purposing SGC natural gas pipelines for hydrogen export

Existing ammonia and fertiliser facilities also indicate that in the mid-term, green ammonia projects could be implemented, decarbonising existing ammonia plants, and potentially producing ammonia for export.

Decarbonisation of fertiliser plants



*Growth of low carbon hydrogen in Azerbaijan (kilotonnes per annum)***
**Hydrogen de-blended at later industrial site*
***Mixture of additional low carbon hydrogen demand and displacing existing grey hydrogen demand which is currently 175 kTPA*

Relevant Policy & Regulations

Azerbaijan has experience in grey hydrogen production through its two large-scale hydrogen plants, one for ammonia and the other for methanol and additional facilities in refinery modernisation projects. Azerbaijan is investing in a low-carbon hydrogen economy with relevant policies and task forces planned or implemented to develop the future of hydrogen and hydrogen derivatives in addition to developing the wider country economy.

2016

Azerbaijan signed and ratified Paris Agreement

2017

Azerbaijan set out Nationally Determined Contribution (NDC) to achieve 35% greenhouse gas reduction by 2030

2021

Announcement at COP26 of 40% GHG reduction and “net-zero emission zone” establishment by 2050

2021

Conduct feasibility studies of using Trans Anatolian Natural Gas Pipeline (TANAP) to transfer blended hydrogen to Europe

There are various enablers and drivers in developing a low-carbon hydrogen economy in Azerbaijan

ENABLERS

- Carbon Border Adjustment Mechanism (CBAM) implementation could incentivise investment in low-carbon hydrogen projects
- Existing gas connections through the southern gas corridor to Europe, providing opportunities for future export of low carbon hydrogen
- Extensive natural gas resources in Shah Deniz field available for low-cost blue hydrogen production and vast natural gas distribution systems
- Potential for future domestic demand in established refining, ammonia, and methanol markets
- High availability of low-cost renewable resources and potential for offshore wind development near Caspian Sea

BARRIERS

- Distance to EU Markets with high pipeline transmission fees could erode competitive advantage of low-cost hydrogen production
- Blending hydrogen into natural gas infrastructure will require commercial arrangements and negotiations with existing stakeholders
- Blue hydrogen potential is dependent on natural gas supply export commitments and CO_2 storage capacity
- Water scarcity
- CO_2 feedstock for production of clean methanol has to be carefully considered

What Azerbaijan needs to build a low carbon hydrogen economy

Azerbaijan Government Actions

A national hydrogen strategy is needed to develop the low carbon hydrogen economy in Azerbaijan, prioritising sustainable development laws and frameworks to incentivise production of low carbon hydrogen while ensuring international laws and regulations are met. Collaboration with neighbouring countries will facilitate exports to the EU.

Plans to increase tax revenues, cut the fiscal deficit, and introduce a carbon tax system should include implementation strategies to ensure short term competitiveness and support as the hydrogen economy is established, whilst planning long term revenue generation for Azerbaijan.

An expansion of the electricity grid in line with future demand should be devised to ensure low cost access to the electricity grid especially from the renewable centres in the west to the eastern coastline.

- Development of hydrogen roadmap and policies
- Financial Incentives and legislation
- Expansion of electricity grid

Maximising Low Carbon Economy Benefits

It is necessary to have a coordinated ramp up of the local supply chain and upskill the workforce in Azerbaijan to enable the costs and risks associated with gigawatt scale hydrogen projects to be reduced and to better realise the true global demand for hydrogen and its derivatives.

- Ramp up supply chain
- Upskill work force

Key Industry Players and Areas of Development in Azerbaijan

Blue hydrogen, whilst having the potential to be lower cost than green hydrogen may be challenging to establish in Azerbaijan in the short term, for three reasons: the uncertainty around CO2 infrastructure/storage, the upstream fugitive emissions and impact on natural gas demand.

The potential for exporting hydrogen through the SGC pipeline system as blended hydrogen in natural gas should be determined with consideration of both the technical and commercial challenges. It will be necessary to conduct technical feasibility studies of blending up to 100% hydrogen into the SGC to future proof the industry.

Work should be done with existing ammonia and methanol production facilities to evaluate incorporating low-carbon hydrogen.

- Blue vs Green Hydrogen
- Natural gas infrastructure for export
- Ammonia and methanol potential

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