NEWSLETTER
ARMENIA

German Economic Team

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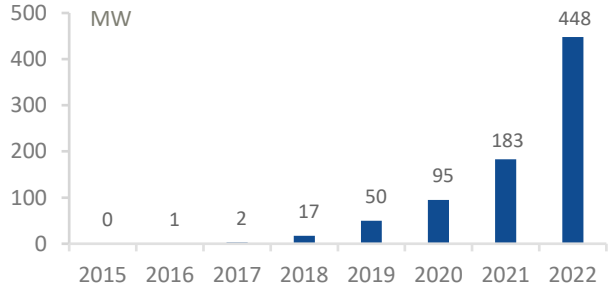
Green hydrogen in Armenia: opportunities and challenges

Armenia's significant solar potential and economic development ambitions have led to debates regarding the possibility of producing green hydrogen in the country. The German Economic Team assessed the production potential as well as possible downstream utilisation and export pathways. Overall, the levelised cost of green hydrogen production in Armenia comes to 3.4 USD/kg, demonstrating economic competitiveness internationally, especially when assuming preferential interest rates for the construction of solar PV park and electrolyser. However, two major aspects decrease the attractiveness of Armenia's green hydrogen sector. Firstly, there is currently no clear business case for utilising hydrogen domestically. Given Armenia's economic structure, potential could exist in copper smelting and fertiliser manufacturing, but neither sector is currently operational. Secondly, Armenia's landlocked position and regional dynamics pose a challenge to exporting green hydrogen to Europe, with transportation and conversion costs decreasing attractiveness. Nonetheless, Armenia's green hydrogen potential could improve through regional cooperation in both the industrial utilisation of hydrogen as well as the joint build-up of export infrastructure.

Armenia possesses significant solar potential

Armenia has significant solar radiation potential in the west of the country. As such the government of Armenia has laid out plans to reach over 1000 MW of installed solar PV by 2030, which would account for 15% of all electricity generation. The scale-up has been quick, with almost 45% of the target already reached in 2022 and new plants coming online in 2023.

Installed solar PV capacity in Armenia



Source: IRENA, IEA

More recently, Armenia's solar potential has however spurred discussions regarding the possibility of building up a domestic green hydrogen sector, which could be used for both the decarbonisation of Armenia's economy, as well as for export to Europe, where announcements of import targets of 10 m tonnes by 2030 present a significant commercial opportunity.

Assessing the potential of green hydrogen in Armenia

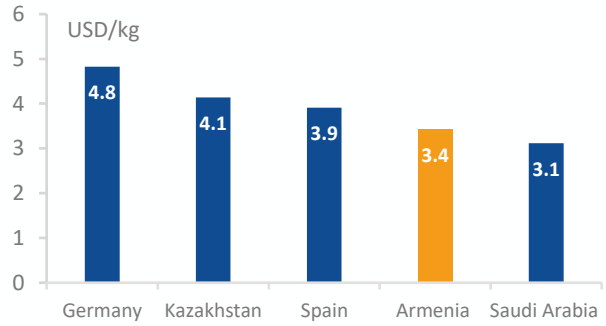
Given the increasing interest and relevance of the topic, the German Economic Team conducted an economic calculation of green hydrogen production costs in Armenia and assessed both the domestic utilisation potential across several sectors, as well as export feasibility. The analysis was conducted using a custom-built levelised cost of green hydrogen (LCOH) production model, which simulates an off-grid hydrogen electrolyser with its own solar PV park.

In view of the importance placed on green hydrogen production globally, the modelling assumed a 2% interest rate, reflecting the ability of Armenia to secure preferential rates. The cost and availability of water were not included in the calculations. Other electricity sources including grid electricity and nuclear power were considered but are not further explored here.

Production costs are at a competitive level

Taking the model specifications into account, Armenia's levelised cost of green hydrogen production amounts to 3.4 USD/kg. Most of this cost stems from the electricity component needed by the electrolyser to operate. Based purely on production costs, Armenia compares favourably to many other countries, with the high solar potential and capacity factors leading to lower LCOH than many other potential producers, including for example, Spain or Kazakhstan.

Cross-country comparison



Source: own calculations

Nonetheless, while production costs themselves do indicate possible international competitiveness, the domestic potential of green hydrogen utilisation, as well as export potential must be assessed.

Not many domestic utilisation cases so far

Following an analysis of the Armenian economic context, three main potential end-uses for green hydrogen were identified and assessed: i) copper smelting, ii) ammonia-based fertiliser production and iii) the transportation sector. While these are not exhaustive, they represent some of the main potential areas.

While the copper smelter at Alaverdi has closed, feasibility assessments are currently being conducted for the construction of a new smelter, which could theoretically use green hydrogen as an input instead of natural gas. However, the size of the smelter and hydrogen requirements are still unclear. The economies of scale of the smelter itself may not be competitive enough, and its capacity alone may also be too small to justify domestic hydrogen production.

Given Armenia's fertiliser needs, a potential end-use could be also the creation of a domestic ammonia-based fertiliser production sector, which utilises hydrogen as a key input. Fertiliser production already exists in Georgia and could therefore lead to the integration of the sectors and associated economies of scale. However, significantly more feasibility analysis is needed to see if Armenia could produce cost-competitive fertiliser for domestic and international markets.

In the transport sector, the use of hydrogen might also be an option. Most of the fleet is currently powered by natural gas and can be thus replaced with hydrogen in theory. However, this would significantly increase costs – especially in comparison to switching to more efficient electrical vehicles. Some minor potential for hydrogen utilisation remains for heavy duty trucks at mine sites, as well as in some limited long-distance transportation.

Export potential is limited by infrastructure

Exporting green hydrogen could in theory present a significant economic opportunity for Armenia, especially given the projected scale-up in demand in Europe over the coming decades. The most energy and cost-effective way to transport hydrogen to the EU would be in a compressed state via pipeline, especially a possible overground pipeline leading through Turkey. This would however require not only significant improvements in regional dynamics, but also high amounts of CAPEX given Armenia's land-locked position. While Armenia does have a gas transportation network which could theoretically be upgraded to allow for hydrogen transport, the entire system is currently owned by Gazprom, making the ability for refurbishment questionable and contingent on other non-economic considerations.

As a second option, Armenia could export its produced hydrogen through Georgian ports via ships, but this entails some conversion losses which would increase overall costs. In addition, the state of Armenia's pipeline infrastructure remains relevant due to the need to firstly transport the hydrogen to Georgia.

The associated costs may however decrease significantly if regional networks and cooperation was in place. The EU has already signalled interest in importing hydrogen from Azerbaijan, Turkey and Kazakhstan, meaning that Armenia could tap into some of the emerging transportation and infrastructural networks needed for green hydrogen exports to Europe, which would however require significant improvements to current regional relations.

Conclusions

Green hydrogen production in Armenia presents both opportunities and challenges. While production costs can be comparatively lower than other countries, the lack of domestic utilisation potential and high costs of exporting hydrogen from Armenia may make the investment into an entire hydrogen production complex challenging. Nonetheless, the sector both in Armenia and globally is still at an early stage, and significant other analysis and feasibility is needed, including alternate uses or export pathways, which may benefit from increased regional co-operation.

This newsletter is based on the Policy Study „Assessment of green hydrogen potential in Armenia“.

Financed by the Federal Ministry for Economic Affairs and Climate Action, the German Economic Team (GET) advises the governments of Ukraine, Belarus*, Moldova, Kosovo, Armenia, Georgia and Uzbekistan on economic policy matters. Berlin Economics has been commissioned with the implementation of the consultancy.
**Advisory activities in Belarus are currently suspended.*

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