This publication is part of the European Climate Initiative (EUKI). EUKI is a project financing instrument by the German Federal Ministry for Economic Affairs and Climate Action (BMWK). The EUKI competition for project ideas is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. It is the overarching goal of the EUKI to foster climate cooperation within the European Union (EU) in order to mitigate greenhouse gas emissions.

Supported by:

Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety

European Climate Initiative EUKI

on the basis of a decision by the German Bundestag

Title: Analysis of the potential for development of the hydrogen economy in (country's name)

Subtitle: analysis	
Version: 1	
Authors: Milieukontakt Albania	
Contact Person: Marcin Błesznowski	
Institution: The Institute of Power Engineering - National Research Institute	

December 2025

TABLE OF CONTENTS

1. INTRODUCTION

Bulqiza is a mining region in Albania where researchers recently discovered nearly pure natural hydrogen gas seeping from underground, estimated at 200 tons per year. The reservoir trapped beneath the Bulqiza chromite mine could hold between 5,000 and 50,000 tons of hydrogen. Despite the country's currently undeveloped hydrogen market, this unprecedented discovery has sparked interest in Albania's hydrogen potential. Globally, hydrogen is emerging as a key energy carrier for decarbonisation. About 95–97 million tons of hydrogen are produced each year worldwide, primarily for oil refining and chemical industries (notably ammonia fertilizer production). Production is currently dominated by fossil-based "grey" hydrogen, obtained from natural gas via steam methane reforming or from coal gasification. To date, 96% of global hydrogen output comes from unabated fossil processes, and low-carbon hydrogen (produced via renewables or with carbon capture) remains <1% of the supply.

Globally, key hydrogen consumers include the refining sector (which uses hydrogen to desulfurize and upgrade fuels) and ammonia production. In Europe, for example, oil refineries consume ~57% of hydrogen and the ammonia industry ~25%, together accounting for 82% of hydrogen demand[1]. Emerging uses, such as hydrogen in steelmaking, long-haul transport (fuel-cell trucks, buses), and power storage, are currently negligible (<0.1% of demand) but are poised to grow as countries invest in hydrogen for the energy transition. Major economies have announced ambitious plans driven by hydrogen's versatility as a clean energy vector. It can store renewable energy, fuel fuel-cell vehicles, and serve as feedstock for green chemicals, and it has the potential to replace fossil fuels in hard-to-abate sectors.

In Albania, the hydrogen sector is still in its infancy. Albania currently has no significant hydrogen production or industrial use, and its energy economy has traditionally relied on abundant hydropower and imported fossil fuels rather than hydrogen. However, Albania like other Western Balkan countries, is increasingly eyeing hydrogen to meet EU climate targets, as they have committed to the EU's 2050 climate-neutrality goal under the Green Agenda for the Western Balkans. Political interest is growing for instance, a large natural hydrogen deposit in Albania's Bulqiza mine (noted above) has highlighted new possibilities, and neighboring countries have begun planning hydrogen projects. Overall, the current market status in Albania is one of exploratory potential rather than actual market activity, making it more critical to examine how global and regional developments could shape Albania's hydrogen economy going forward. Below, we detail the state-of-the-art and numbers of the hydrogen market, the factors influencing its development, the barriers and legal frameworks, support mechanisms, future scenarios, and recommendations for accelerating a hydrogen economy in Albania.

2. HYDROGEN MARKET IN DETAIL AND NUMBERS

2.1 Size of Albania's Hydrogen Market vs. EU Countries

Currently, Albania's hydrogen market is virtually non-existent. There are no commercial hydrogen production plants, and hydrogen consumption within the country is negligible. In contrast, the European Union consumes approximately 7.9 million tons of hydrogen each year, primarily for use in the refining and fertilizer industries. Major EU economies such as Germany, the Netherlands, Poland, and France use hundreds of thousands of tons of hydrogen per year in industrial processes. However, Albania has no comparable industrial demand centers, such as large refineries or ammonia plants. Even the country's small oil refinery frequently sits idle, meaning hydrogen use in Albania is effectively zero. Western Balkan neighbors are only beginning to develop hydrogen. For example, Serbia has announced a 30,000-ton-per-year clean hydrogen facility for 2028. Thus, while Albania's current hydrogen market is minimal, there is recognition that it may need to grow as the country aligns with EU decarbonization trends.

2.2 Hydrogen Production Methods and CO_2 Emissions

Currently, any hydrogen used in Albania is likely limited to small-scale applications and is produced using imported industrial gases or on-site fossil fuel methods since no green hydrogen plants are operating yet. Globally and in the EU, most of the hydrogen is "gray" produced from natural gas via steam methane reforming (SMR) or "brown" or "black" from coal gasification. These methods emit significant CO_2. These carbon-intensive methods make hydrogen production one of the largest industrial sources of CO_2 emissions (approximately 900 million tons globally in 2020). Using such methods in Albania would conflict with the country's low-carbon goals. Clean production methods include "blue" hydrogen (fossil-based with CO_2 capture) and "green" hydrogen (produced via water electrolysis using renewable electricity). Green hydrogen has near-zero greenhouse gas emissions at the point of production (only water vapor is emitted when hydrogen is used); however, its life-cycle carbon footprint depends on the source of electricity. Albania's advantage lies in its renewable-heavy power sector; over 95% of domestic electricity comes from hydropower in wet years. This means that electrolyzes could be powered by very low-carbon electricity. However, efficiency losses from electrolysis and compression require significant renewable capacity. In summary, hydrogen production in Albania could be very clean if tied to renewables, thus avoiding the heavy CO_2 emissions of gray hydrogen.

2.3 Price Volatility of Grey Hydrogen

The cost of grey hydrogen is closely linked to natural gas prices, making it highly volatile. In recent years, Europe saw this volatility firsthand: the 2021–2022 spike in gas prices temporarily made grey hydrogen more expensive than green hydrogen in some cases. In 2022, the production cost of grey hydrogen in Europe was as high as €9–11 per kg, whereas green hydrogen (with fixed renewable electricity costs) remained ~€5–6 per kg. Albania, which currently imports all its natural gas and has very limited gas usage, would face price instability if it depended on grey hydrogen, since global gas market swings could sharply raise costs. By contrast, green hydrogen costs depend on capital and electricity costs; while presently high, they are expected to steadily decline with scale and technology improvements. A recent techno-economic assessment for Albania estimated the Levelized Cost of Hydrogen via electrolysis at about €7.7–8.8 per kg (depending on using solar or grid power) under current conditions, which is higher than historical grey hydrogen prices (~€1.5–2/kg) but could become competitive if natural gas prices spike again or if carbon costs are imposed. This underscores that grey hydrogen's price advantage is highly contingent on cheap gas, a precarious prospect, whereas investing in green hydrogen could bring more stable long-term costs (in addition to climate benefits).

2.4 Hydrogen application sectors

Hydrogen's role varies across sectors, and Albania's future hydrogen demand will depend on which applications develop. Globally and in the EU, refineries and ammonia/fertilizer plants are the dominant hydrogen consumers (over 80%)[1]. Other uses include methanol production, chemicals, and steelmaking. Albania *lacks* most of these heavy industries. It has no domestic ammonia fertilizer production, and its oil refinery has been largely offline. Thus, there are currently no major "built-in" hydrogen consumers in Albania's economy. However, looking forward, potential applications include: Ammonia or e-fuel production for export (if Albania produces green hydrogen at scale, it could be combined with nitrogen or CO_2 to make ammonia or synthetic fuels, leveraging export routes via ports); steel and metals (while Albania doesn't have primary steel mills, hydrogen could be used in metal processing or new steel mini-mills if developed regionally); and refining (any revival or modernization of Albania's refinery could incorporate hydrogen for cleaner fuels). The most likely domestic use case in the medium term is transportation and power storage. The transport sector is Albania's largest source of CO_2 emissions, so hydrogen fuel-cell vehicles (buses, heavy trucks) or hydrogen-powered trains could help decarbonize routes that are hard to electrify. Hydrogen can also be used in gas turbines for electricity generation or stored for seasonal power supply balancing. Another potential application is in the building sector via blending hydrogen into natural gas for heating, but Albania's gas grid is very limited currently. In summary, sectoral demand for hydrogen in Albania will not materialize automatically. It will require proactively creating uses such as adopting hydrogen in public transport fleets, encouraging industrial fuel switching, or producing green ammonia as a new export commodity.

2.5 Contribution of low-emission hydrogen to total hydrogen production

At the global and European level, the share of "low emission" hydrogen (green or blue) in total production is *very small* but growing. The International Energy Agency estimates that in 2023, less than 1 Mt out of 97 Mt of hydrogen was produced via low-carbon pathways. Essentially, >99% is still high-emission grey or brown hydrogen. For Albania, this metric is zero since *virtually no hydrogen is produced domestically at all*. Given Albania's renewable resources, the country can *design* from the start to be low emission (green). This could allow Albania to "leapfrog" directly to a green hydrogen economy rather than ever relying on grey hydrogen. It also means Albania's baseline share of low-emission hydrogen is effectively 0% now, but any new projects (like a proposed solar-to-hydrogen plant) would raise that share.

2.6 Hydrogen infrastructure – electrolysers, HRSs, dedicated pipelines

As mentioned, Albania has no dedicated hydrogen infrastructure. There are no electrolyser installations reported at commercial scale (only possibly laboratory-scale units at research institutions). Likewise, no hydrogen refueling stations exist in the country, as there are no fuel-cell vehicles in use yet.

In terms of pipelines, Albania's gas pipeline network is limited. The country is crossed by the Trans-Adriatic Pipeline (TAP) carrying natural gas from Azerbaijan to Italy. TAP's operators have begun studying hydrogen blending; an initial feasibility study in 2021 confirmed TAP could potentially transport a hydrogen–natural gas blend in the future. However, this would require significant upgrades. Within Albania, there is currently *no internal hydrogen pipeline* or storage network. Any near-term hydrogen projects would likely rely on onsite production and use (for example, hydrogen produced at a solar farm and converted to ammonia on-site, or used in a nearby industrial process), or transport via cylinders/tankers for small volumes. The infrastructure gap is a major challenge – the International Energy Agency notes that a lack of delivery infrastructure is holding back hydrogen implementation globally, and this is even more pronounced in Albania. On a positive note, Albania's small size could allow a more centralized infrastructure approach (e.g., one or two hydrogen hubs rather than an extensive pipeline grid). Plans are being discussed in the region for a "Hydrogen Backbone" pipeline network by 2040 that could connect Southern Europe (including the Western Balkans) to demand centers in Central Europe, potentially repurposing existing gas pipelines. For Albania, tapping into such regional infrastructure, or leveraging the TAP corridor for export, will be important if it aims to produce hydrogen at scale.

3. DETERMINANTS OF DEVELOPMENT

3.1 National strategies for hydrogen development

Albania does not yet have a dedicated national hydrogen strategy or roadmap (as of 2025). The government has, however, acknowledged the importance of diversifying its energy mix and exploring new technologies. The Minister of Infrastructure and Energy has cited hydrogen as a potential pillar in Albania's future energy diversification strategy, but concrete plans remain to be formulated. In 2021, Albania adopted its National Energy and Climate Plan (NECP) for 2021–2030, which primarily focuses on renewables and efficiency; hydrogen received only brief mention as a long-term opportunity. Recognizing this gap, international institutions are urging action. The European Bank for Reconstruction and Development and the UN Economic Commission for Europe (UNECE) have both highlighted that Western Balkan countries need to develop hydrogen strategies to align with EU climate goals. Such a strategy would set national targets (for the production or use of green hydrogen), identify priority projects, and outline regulatory support. Some peers in the region are moving ahead. For example, North Macedonia has drafted elements of a hydrogen strategy, and Serbia announced plans for one. In the absence of a hydrogen-specific strategy, Albania is currently guided by broader policies (like the NECP and Renewable Energy Law), which indirectly support hydrogen by promoting renewables.

3.2 Regional Decarbonisation Strategies Including Hydrogen

Albania's hydrogen development is closely linked to regional efforts under the Green Agenda for the Western Balkans, which mirrors the EU Green Deal. The Green Agenda (endorsed in Sofia, 2020) commits Albania and its neighbors to climate neutrality by 2050 and includes action areas like clean energy, circular economy, and depollution. While it doesn't single out hydrogen explicitly, hydrogen is implicitly a part of the clean energy transition pillar, seen as a "fuel of the future". Regionally, Western Balkan countries are also coordinating through the Energy Community, integrating hydrogen into its framework, for instance by launching a Hydrogen Coordination Group and preparing to adopt EU hydrogen legislation once finalized. Moreover, the

EU's Economic and Investment Plan for the Western Balkans allocates funding for renewable energy and infrastructure, some of which could support hydrogen projects. This includes €9 billion in grants and €20 billion in guarantees for green transition investments in the region. Under this regional decarbonisation push, several Western Balkan countries have initiated pilot hydrogen initiatives (e.g., Serbia's aforementioned hydrogen facility with Chinese partners, and Croatia's plan for 70 MW of power-to-hydrogen by 2030). These efforts create a supportive environment for Albania as neighbors and regional bodies prioritize hydrogen, Albania can collaborate and share knowledge. For instance, a Western Balkans Hydrogen Roadmap (supported by the EBRD and EU) is being discussed to coordinate efforts across the six countries. Albania is also part of cross-border decarbonisation projects where hydrogen may feature.

3.3 Potential RES vs. Hydrogen potential production

Albania's prospects for green hydrogen hinge on its renewable energy resources. Albania is named the "Sleeping Renewable Energy Giant" of the Balkans due to its substantial untapped solar, wind, and hydro potential. Today, Albania already generates nearly all its electricity from renewables (mostly hydropower), but it experiences seasonal imbalances – oversupply in wet seasons and deficits in dry seasons. This excess hydroelectricity in wet years could be used to produce hydrogen instead of being spilled or exported at low prices. Moreover, solar irradiation in Albania is among the highest in Europe, and wind mapping shows strong wind corridors in the country. According to IRENA, Albania has thousands of megawatts of feasible solar and wind capacity waiting to be developed. Translating this into hydrogen, Albania could dedicate a portion of new solar/wind farms to electrolysers that produce green hydrogen. A rough calculation illustrates the potential: 1 GW of solar PV in Albania could produce on the order of 15,000–20,000 tons of hydrogen per year if coupled with electrolysers. Indeed, proposals are emerging – for example, the Italian firm Saipem has signaled plans to build 635 MW of PV in Albania specifically to power hydrogen electrolysis. Another initiative by Fortis Energy (Turkey) would integrate 644 MW of renewables in Albania with electrolyser capacity. These indicate that investors see Albania's renewable potential as a springboard for hydrogen. Additionally, Albania's mountainous geography holds pumped hydro storage opportunities (Statkraft is exploring a large, pumped storage plant), which could complement hydrogen storage for balancing renewables. One challenge is that Albania's hydro resources vary year to year, so using them for steady hydrogen output might be tricky, but integrating new solar/wind can provide more consistent input to electrolysers.

3.4 Leaders creating a hydrogen economy – main investors, component producers, etc...

Because Albania's hydrogen sector is nascent, the "actors" are currently those laying the groundwork for future projects. Government bodies will play a central role, primarily the Ministry of Infrastructure and Energy, which is responsible for energy policy and would oversee any hydrogen strategy or regulation. The national power utility (KESH) and transmission operator (OST) could become players if hydrogen is used for energy storage or grid services. On the private side, a few early attempts have appeared via MoUs: Saipem, a major Italian energy contractor, and Alboran Hydrogen have agreed to develop a green hydrogen project in Albania. According to

Saipem, they have already identified a site (in Fier County) and aim to produce green ammonia for export using Albanian renewables. Fortis Energy, a Turkish renewables firm, is another notable investor planning nearly 0.65 GW of wind/solar and associated hydrogen production in Albania as part of a broader Balkans investment. These foreign investors are bringing capital and know-how, often encouraged by Albania's favorable solar/wind potential and proximity to EU markets. International donors and financial institutions are also key actors: the EBRD has conducted a "Low-Carbon Hydrogen Economy in Western Balkans" study and could finance pilot projects; the EU (through the Western Balkans Investment Framework) can provide grants; and organizations like UNECE are offering policy support. On the domestic front, Albania's academic and research institutions (such as the Polytechnic University of Tirana, which was involved in the Bulqiza hydrogen discovery) are emerging stakeholders for innovation and talent development. It's worth noting that as the hydrogen ecosystem grows, new actors will likely emerge. In summary, the current cast of hydrogen actors in Albania is small but includes influential players – government agencies setting the agenda, foreign investors initiating flagship projects, and international organizations providing support and expertise all of whom will shape the pace of hydrogen development.

3.5 Potential new applications and new users

Developing a hydrogen economy requires cultivating end-use applications (the "demand" side), such as:

Transportation: Albania's largest emissions source is road transport. Hydrogen fuel-cell electric vehicles could serve heavy-duty transport, buses, and potentially maritime transport. For example, city buses or inter-city coaches running on hydrogen could eliminate diesel emissions; the government could pilot this in Tirana's public transit. There is also interest in hydrogen-fueled vessels in the Adriatic, and ports like Durrës could serve as refueling hubs for hydrogen or ammonia-powered ships, given their strategic location.

Industry: Albania's industrial sector is relatively small, but there are still hard-to-abate industries. Cement production (Albania has several) is one – hydrogen could potentially be used as a high-temperature heat source or as part of low-CO_2 cement processes. Steel: Albania produces steel via electric arc furnaces using scrap; however, if any direct reduced iron (DRI) processes were introduced, green hydrogen could serve as the reductant instead of natural gas. Oil refining (if the Ballsh refinery reopens or a new refinery is built) would be a direct consumer of hydrogen for hydrotreating fuels. Fertilizer or chemicals: While Albania doesn't have an ammonia plant, conceivably, a green ammonia facility could be built for export (using nitrogen from air and hydrogen from water). This would create a major industrial use and an export product (green ammonia).

3.6 Potential of hydrogen storage in salt caverns

Hydrogen can be a form of stored energy to buffer Albania's electricity system. For example, excess renewable power in spring could produce hydrogen, which is stored and then used in winter to generate electricity via turbines or fuel cells, thus improving energy security. Albania is considering new gas-fired power plants (like the Vlora TPP conversion to gas); designing these to be hydrogen-capable (blend or switch) would create a future use for hydrogen.

A "user" of hydrogen produced in Albania might be external, i.e., export customers. Green hydrogen could be exported to EU countries. For instance, Italy and other EU states have hydrogen import targets. This would effectively make foreign off-takers (like European utilities, shipping companies, or chemical companies) the end-users of Albanian hydrogen. The planned green ammonia facility by Saipem in Albania is precisely targeting export, ammonia can be shipped and then cracked back to hydrogen or used directly in fertilizer or shipping fuel.

To realize these new applications, initial pilot projects and partnerships will be key. For example, Albania could convert a few municipal buses to hydrogen fuel cells in a demonstration with EU funding, which would build know-how and public acceptance. Another pilot could be powering a remote mountain tourist site with a solar-powered electrolyser and hydrogen fuel cell (as a microgrid).

Albania might partner with a neighbor (e.g., co-develop a hydrogen ferry line with Montenegro across Lake Shkodra, or supply hydrogen to North Macedonia's steel mill). The user base for hydrogen in Albania will not grow organically without these proactive steps, because currently, hydrogen is not a part of any Albanian sector. But with the right investments, new users can emerge in heavy transport, industry, power, and export markets, gradually creating a domestic hydrogen ecosystem. Notably, many of these applications (buses, power plants, etc.) involve public or regulated entities, meaning government support and policy will strongly determine whether they materialize.

Large-scale hydrogen economies benefit from the ability to store hydrogen in bulk, typically in underground salt caverns (as done in the UK, USA, etc.), which offer secure, high-capacity storage for seasonal balancing. Albania, however, has no known suitable salt dome or salt cavern formations for hydrogen storage. The geology of Albania is dominated by mountainous limestone, flysch, and some oil-bearing sedimentary structures, but not large salt diapirs like those in Northern Europe. This means Albania cannot easily develop the type of massive underground hydrogen storage. For instance, Albania does have depleted oil and gas fields (e.g., in Patos-Marinza, one of the largest onshore oil fields in Europe). In theory, these could be candidates for porous media storage of hydrogen after appropriate site assessments, similar to how natural gas is stored in depleted fields. Overall, the lack of salt caverns means Albania's hydrogen projects might operate on a "produce as needed" basis or convert H_2 into exportable products rather than storing large volumes. For example, a green hydrogen plant might directly synthesize ammonia for export, obviating the need to store hydrogen gas for long periods. In the long run, if Albania were to integrate into a regional hydrogen network, it might utilize storage facilities in neighboring countries. In conclusion, while Albania's geology is not favorable for the cheapest form of bulk H_2 storage, this is a known limitation that will shape its hydrogen deployment, likely pushing it toward immediate use or export of produced hydrogen, or investment in man-made storage solutions.

4. BARRIERS

4.1 Main barriers to the development of the hydrogen economy – law, CAPEX, OPEX, decision-making process

A significant barrier in Albania is the lack of a dedicated legal/ regulatory framework for hydrogen. Currently, hydrogen is not well-defined in Albanian energy law. There are no specific provisions for hydrogen production, transport, storage, or trading. Important regulations that are commonplace in mature hydrogen markets (e.g., safety standards for hydrogen handling, codes for hydrogen pipelines, certification schemes for green hydrogen, licensing of hydrogen production facilities) are absent. This creates uncertainty for investors and project developers. Additionally, market rules that would allow hydrogen blending into natural gas pipelines or selling hydrogen-derived electricity are not yet developed. The Renewable Energy Law (2023) and related bylaws touch on concepts like renewable gas and Contracts for Difference, but they do not explicitly cover hydrogen beyond mentioning renewable transport fuels. Another regulatory gap is coordination between sectors. Hydrogen lies at the nexus of power, gas, transport, and industry. Albania's regulatory bodies (electricity regulator, etc.) have not yet established roles or collaboration mechanisms for a cross-cutting hydrogen value chain. This can lead to bureaucratic bottlenecks. Administrative capacity is also a concern. Regulators and ministries lack expertise in hydrogen technologies, causing delays or overly cautious rules.

The economics of hydrogen projects in Albania are challenging. High capital expenditures are required for electrolysers, compressors, storage tanks, and fuel cells, which are all still expensive technologies. Operational costs (OPEX) also heavily influence green hydrogen cost, and while Albania's electricity is relatively cheap when hydro is abundant. The result is that private investors perceive hydrogen projects as high-risk in Albania right now. A related issue is access to finance: local banks may be unfamiliar with hydrogen and hesitant to lend, while international financiers will look for government backing or guarantees to de-risk projects. There's also the risk of demand not materializing – an investor could build a hydrogen plant and then find no one to buy the hydrogen at a viable price. This "chicken-and-egg" problem (no demand because no supply, and no supply because no demand) is a classic hurdle in new energy tech deployment.

The broader context is that even globally, hydrogen is not yet fully cost-competitive for many uses, and Albania, with its small economy, has limited ability to absorb high costs without external help. Therefore, investment risk is high, and early projects will require risk mitigation (grants, off-take guarantees, or carbon pricing to improve competitiveness).

4.2 Environmental aspects - how much it hinders the development of the hydrogen economy

While hydrogen is advertised as a green solution, its development can raise environmental and community concerns that act as barriers. One issue is water usage. Albania is not water-scarce on a national level, but it does face seasonal droughts and local water stress. Large electrolysis facilities might draw on water resources that communities use for drinking or irrigation, potentially causing conflicts.

Another concern is land use and biodiversity. To produce hydrogen on a scale, expansive solar fields or wind farms will be needed to power electrolysers. Local opposition can arise if these renewable projects are sited on arable land or near sensitive ecosystems.

Safety concerns are also salient. Hydrogen is extremely flammable and has a wide ignition range. There may be public apprehension about hydrogen facilities, trucks, or pipelines, especially considering past accidents in the chemical industry. Albania will need robust safety regulations to assure communities that hydrogen can be handled without undue risk.

On the environmental side, while hydrogen use produces no CO_2, leaks of hydrogen gas into the atmosphere could have an indirect greenhouse effect.

Permitting processes for hydrogen projects will require environmental impact assessments under Albanian law – a novel exercise for regulators and developers, which could slow projects. Finally, if natural hydrogen extraction (as in Bulqiza) were pursued, it might involve drilling and disturbance in new areas, raising questions about geological risks or impacts on groundwater.

Social license to operate will be critical. Early engagement with communities and transparency about hydrogen's benefits (and risks) will be needed to avoid the kind of public resistance that has sometimes met other energy infrastructure.

In summary, environmental and social factors, from water and land impacts to safety perceptions, form a barrier that must be dealt with through careful planning, technology choices, and stakeholder engagement.

4.3 Critical raw materials as one of crucial aspect of electrolysers manufacturing

The hydrogen economy relies on advanced technologies that, in turn, depend on certain raw materials and global supply chains. For instance, electrolysers (especially PEM types) use rare materials like iridium and platinum as catalysts; fuel cells also use platinum-group metals. These metals are not produced in Albania and are globally scarce, meaning reliance on imports from a few countries. If many nations ramp up electrolyser production simultaneously (as is happening), supply bottlenecks or price spikes in these materials could occur, delaying projects or raising costs in Albania. Furthermore, the manufacturing of electrolyser components, storage tanks, and fuel cells is concentrated in a few countries (Europe, USA, China, Japan). Albania currently has no manufacturing base for these, so it must import the equipment. Long lead times for equipment delivery can be a barrier. Any trade restrictions or geopolitical issues could also affect access. On the other side, there is an opportunity for Albania or the region to localize some parts of the supply chain. Experts suggest the Western Balkans, particularly Serbia, could produce components like bipolar plates, membranes, or other electrolyser/fuel cell parts, given its metal-processing industry. However, developing such manufacturing capacity will take time and investment.

Another raw material consideration is the availability of renewable energy equipment. A hydrogen push will greatly increase demand for these, and Albania will be competing with other countries for solar modules, wind turbines, and batteries (for integrated systems). Any delays or price increases in renewables deployment directly slow hydrogen production capacity growth.

In conclusion, Albania's hydrogen plans could be bottlenecked by external supply constraints on technology and materials. As a small market, Albania might not get priority if global demand outstrips supply. This barrier reinforces the need for regional collaboration, e.g., joint procurement of equipment and carefully planning projects to realistic timelines, considering procurement. It also suggests Albania should keep an eye on global technological developments.

4.4 Availability and cost of infrastructure

Building the hydrogen infrastructure from scratch in Albania will be capital-intensive and logistically challenging. If Albania were to distribute hydrogen across the country or export it via pipeline, it would need to either repurpose natural gas pipelines or construct new ones with appropriate materials. Albania's existing gas network is very limited, only some industrial branches and the TAP transit line.

Each hydrogen refueling station (HRS) capable of serving cars/buses can cost $1–2 million (with compression, storage, and dispensers). Given Albania's size, even establishing a basic network of HRS along main corridors and cities could involve tens of millions of euros and require training personnel for maintenance and safety.

Large electrolysers (tens of MW) will need strong grid connections or direct renewable hookups. Albania's grid in some areas might need reinforcement to handle new loads. All these infrastructure elements face the challenges of difficult terrain (in mountainous areas) and sometimes underdeveloped transport networks to move heavy equipment.

Economies of scale are critical. A single project might bear prohibitive unit costs, but coordinated scaling could lower them.

Another aspect is cross-border infrastructure. Connecting to regional pipelines or networks could spread costs, but coordinating investments and regulations with neighboring countries can be complex. For example, if Albania hopes to export hydrogen to Italy, it might look at sending hydrogen through TAP or by ship. Converting TAP fully to hydrogen would mean renegotiating its usage (currently dedicated to natural gas till at least the 2030s) and investing in compressor modifications; shipping hydrogen or ammonia requires port facilities (specialized terminals, storage tanks) that Albania doesn't yet have. Developing the Port of Durrës or Vlora for ammonia export could cost hundreds of millions. Therefore, high infrastructure costs and low initial utilization form a barrier. This can be alleviated with government support or anchor consumers.

In summary, establishing a hydrogen supply chain in Albania from production to end-use requires significant infrastructure investment, and the difficulties in financing and executing these projects, given Albania's topography, small market, and need for integration, constitute a serious barrier that must be planned for with robust funding strategies and regional cooperation.

5. LEGAL CONDITIONS

5.1 European directive (RED II, RED III, Fit for 55) and its influence on hydrogen economy development

As an EU membership candidate and member of the Energy Community, Albania is in the process of aligning its laws with the EU's clean energy directives. This has a direct impact on hydrogen policy. The Renewable Energy Directive II (2018/2001/EC), which Albania transposed in 2023, introduces concepts highly relevant to hydrogen, such as "renewable fuels of non-biological origin" (RFNBO). RED II (and the newer RED III under the Fit for 55 package) set targets for the use of RFNBOs in transport and industry. For example, RED II calls for 14% renewable energy in transport by 2030, and RED III raises ambitions further, including a sub-target for RFNBOs in industry and transport (proposed 2.6% of transport energy by 2030 from RFNBOs, and 50% of hydrogen used in industry to be renewable by 2030). Albania will be expected to incorporate these targets. Within a few years, Albanian law should require a certain share of hydrogen (and e-fuels) in its transport fuel mix, even if that hydrogen is initially imported due to a lack of domestic production. Similarly, EU fuel quality and gas directives being updated under Fit for 55 include provisions for allowing hydrogen blending in natural gas grids and defining hydrogen network operators. The Fit or 55 package (which includes the Gas Decarbonisation Package and amendments to RED, ETS, etc.) will influence Albania via the Energy Community decisions. For instance, the Energy Community in 2022–2023 has been preparing to adopt parts of the Fit for 55, which could require Albania to implement carbon pricing (ETS) by 2026 and CBAM (Carbon Border Adjustment Mechanism) for exports to the EU thereafter. These measures indirectly push hydrogen: a carbon price on fossil fuels will make green hydrogen more competitive, and CBAM will penalize carbon-intensive products (like ammonia or steel) exported to the EU, creating an incentive for Albania to produce them with green hydrogen in the future to avoid tariffs.

Another directive, the Alternative Fuels Infrastructure Regulation (AFIR), will set binding targets for hydrogen refueling stations along core transport corridors in the EU – while Albania is not in the EU, if it joins or if it wants to integrate its transport with the EU (for tourism, freight), it may need to provide comparable infrastructure.

In summary, EU directives and the Fit for 55 agenda effectively set the direction for Albania's hydrogen policy. They create the targets and definitions that Albania will follow. Albanian national law is already adjusting, for example, Law 24/2023 on Renewables is aligned with RED II, and future laws will incorporate RED III requirements. The country will thus have to implement rules for Guarantees of Origin for renewable hydrogen, sustainability criteria, and likely contribute to EU-wide hydrogen goals. This external legal push ensures that hydrogen remains on Albania's policy radar and can help justify domestic action, but it also could be challenging if Albania lacks the means to meet the targets.

5.2 How national laws support the development of low-emission hydrogen production and other components of the hydrogen value chain

The transposition of EU directives and the adoption of Energy Community decisions mean Albanian national law is gradually being updated to accommodate new energy concepts, including hydrogen. As noted, Albania's Renewable Energy Law (No. 24/2023) is a prime example – it introduced a new national renewable target (54.4% by 2030) and made provisions for renewable energy communities and contracts for difference, laying some groundwork for supporting technologies like hydrogen. However, more specific legal instruments are needed. Likely areas of change shortly include:

- <u>Energy Strategy and Planning</u>: Albania's next National Energy Strategy or an update to its NECP will likely incorporate hydrogen pathways, mandated by the need to align with EU targets. This will influence planning documents and perhaps set domestic hydrogen production targets or pilot projects by a certain date.
- <u>Gas Market Law</u>: Albania will have to modify its gas legislation to incorporate hydrogen blending and pure hydrogen networks. The EU's draft Hydrogen and Decarbonised Gas Market Directive will, when adopted, require unbundling of hydrogen network operators, third-party access rules, tariffs, etc. If Albania wants to use its gas infrastructure for hydrogen, it will mirror these rules. This may mean empowering the national energy regulator (ERE) to regulate hydrogen pipelines and set quality standards for hydrogen gas

blends.

- Transport and Fuel Standards: Albania's fuel regulations (which currently deal with petrol, diesel, LPG, etc.) will need amendments to recognize hydrogen as a transport fuel. This includes safety standards for hydrogen fueling stations, vehicle homologation standards for FCEVs, and possibly incentives such as excise duty exemptions for green hydrogen.
- Industrial Policy: Albanian law may introduce incentives or requirements for industry to use clean hydrogen. Additionally, investment incentive laws (like corporate tax relief for strategic investments) could list hydrogen production facilities as eligible, steering domestic law towards supporting the hydrogen value chain.
- Environmental and Safety Regulations: National safety codes (fire, pressure vessels, etc.) will be updated to include hydrogen explicitly. Likewise, environmental permitting will incorporate hydrogen production under specific categories (electrolysis plants might be treated similarly to chemical plants for EIA purposes).

Overall, the influence on Albanian law is progressive but accelerating. A crucial influence is the Energy Community Treaty. Decisions made there become binding on Albania. This external legal timetable ensures that, even if Albania's domestic drive were weak, it would still be legally obliged to develop frameworks for hydrogen. The country's lawmakers and regulators thus need to prepare. The influence is also seen via donor technical assistance: EU-funded projects help draft secondary legislation for renewables and could do the same for hydrogen (writing rules for Guarantees of Origin, for instance).

A critical aspect of legal conditions is what direct support Albanian law provides (or will provide) to encourage hydrogen production, infrastructure, and use – essentially, the incentives and protections for investors across the hydrogen value chain. At present, there are few, if there are any, explicit legal support measures for hydrogen.

There are no dedicated subsidies or feed-in tariffs for producing hydrogen (unlike for renewable electricity, where Albania has auctions and feed-in contracts for solar/wind). However, the new law does allow Contracts for Difference (CfD) and premium contracts for renewable energy projects. It's conceivable that a green hydrogen project could benefit indirectly, e.g., by securing a cheap renewable PPA via a CfD to lower its electricity cost, or by being declared a "demonstration project" under the law to receive special support. The law specifically introduces demonstration projects for innovative tech, which could be applied to a first hydrogen project, giving it perhaps tax breaks or simplified permitting.

On the usage side, Albanian legislation has not yet implemented incentives like fuel subsidies or vehicle incentives for hydrogen. The National Transport Plan and related strategies might be updated to promote alternatively fueled vehicles, including hydrogen, which would pave the way for legal incentives.

Risk mitigation instruments could also be encoded in law or policy. For example, allowing state loan guarantees for hydrogen infrastructure or creating an insurance fund for hydrogen projects. While not present now, these might come as part of a hydrogen strategy package.

It's also worth noting the value chain scale: production, storage, distribution, and end-use all may need tailored support. A holistic legal approach would ensure that incentives aren't just for producing hydrogen but also for building refueling stations and for consumers to adopt hydrogen technologies. Currently, because hydrogen isn't commercially present, none of these links have targeted support.

As of now, legal support for the hydrogen value chain in Albania is mostly aspirational; the need for it is recognized conceptually, but concrete mechanisms are not yet in place. Until those materialize, the value chain will rely on general provisions (like the demonstration project clause) and donor support rather than strong domestic legal incentives.

6. SUPPORT INSTRUMENTS

6.1 Qualification of support instruments

To promote a hydrogen economy, a variety of support instruments can be deployed. Given that Albania is at the start of this journey, it can design its support toolkit by learning from others. Key support tools might include:

- Capital Grants and Investment Subsidies. Direct grants for feasibility studies or pilot projects are often provided by international donors. For instance, the EU's Western Balkans Investment Framework (WBIF) can fund pilot hydrogen projects or related studies; similarly, bilateral donors (e.g., Germany's KfW or GIZ) might offer grants for electrolyser pilot installations. These reduce the upfront cost burden. Projects may qualify by being "innovative" or contributing to Albania's climate targets.
- Concessional Loans. Institutions like the EBRD or World Bank can extend loans with low interest or long drifts for green projects. If a company wants to build a solar-to-hydrogen plant, an EBRD loan with favorable terms could be a support tool. The IFC also has programs to finance clean energy in emerging markets (hydrogen could fall under it).
- Feed-in Tariffs/Premiums or CfD for Hydrogen. While feed-in tariffs typically apply to electricity, an analogous mechanism can support hydrogen. For example, a Contract for Difference (CfD) could guarantee a green hydrogen producer a certain price per kg of H_2 above market rates. The difference would be paid by a government fund or through carbon credit revenues.
- Tax Incentives. Albania could waive import duties or VAT on hydrogen production equipment (electrolysers, storage tanks, fuel cells) to reduce project costs.
- Operational Subsidies - In transport, for instance, the government might subsidize the fuel cost difference for public bus operators to use hydrogen instead of diesel, at least initially. This ensures there is demand while the cost is higher.
- Quotas/Mandates. A powerful non-financial support is mandating usage – e.g., requiring that a certain percentage of public buses be zero-emission (could be battery or hydrogen) by 2030, or that any new gas-fired power capacity must be hydrogen-ready. These create a guaranteed market for hydrogen solutions. Under EU influence, Albania will likely introduce a quota

for renewable fuels in transport.

- Donor-Funded Programs - There are programs like Horizon Europe, EUKI, etc., that include Western Balkan partners. UNDP or UNIDO might run capacity-building projects on hydrogen that bring expertise and small-scale equipment. These are softer support instruments that build the ecosystem (human capital, research, awareness).
- Support Qualification. Each support tool will have criteria. For example, to qualify for a hypothetical green hydrogen production subsidy, a project might need to prove it uses renewable power and meets an efficiency standard (ensuring it's truly "green"). To get donor grants, projects often must demonstrate climate additionality or innovation.

Currently, the main active support in Albania is through international funding. The EU IPA III funds and the Green Agenda Action Plan include support for innovative energy; hydrogen pilots could tap into these. The EBRD and EU recently launched a Western Balkans Guarantee facility to mobilize private investments in green projects; hydrogen could benefit if packaged right.

In summary, Albania has a range of support instruments at its disposal, from financial incentives (grants, loans, subsidies) to regulatory mandates and partnerships, but these need to be operationalized. Early on, it will rely heavily on donor and IFI-led instruments, gradually building domestic schemes like premium contracts or tax incentives as the market gets ready. The design of these tools must ensure they target the whole value chain: production, distribution, and consumption, to avoid bottlenecks. The qualification criteria should ensure support goes to genuinely low-carbon hydrogen (preventing any "greenwashing" with grey hydrogen) and to projects that contribute to Albania's strategic goals (job creation, export potential, etc.).

6.2 Level of subsidizing/funding

The scale of financial support needed for hydrogen in Albania is significant relative to its economy, so managing expectations and planning funding sources is crucial. Albania will operate on a much smaller absolute budget, but potentially higher relative subsidies per project, given the lack of economies of scale initially. Some indicative expectations:

A small pilot project (of 1 MW electrolyser with solar) might need a grant covering 40–50% of its cost to make it viable. This could be a few hundred thousand euros. Such levels are plausible through EU grant mechanisms.

Larger projects (100+ MW scale) would likely only happen with a combination of private investment, debt, and substantial public support (multi-million-euro grants or soft loans). The Albanian government itself has limited fiscal space, so most subsidies might come via EU blending facilities or climate funds. However, Albania might allocate some portion of its national budget or sovereign green bonds to support hydrogen if it becomes a priority.

On the demand side, subsidizing hydrogen fuel initially might involve the government tolerating the higher cost in public procurement. These subsidies could be phased down as hydrogen gets cheaper.

The expectation is that nowadays, hydrogen needs substantial subsidies, but by the mid-2030s, costs should fall, and carbon pricing will improve competitiveness. Additionally, donor expectations come into play. They typically want to see host country co-financing or policy commitment. So, Albania might need to commit some of its funds (even if modest) to leverage larger donor subsidies.

The power sector experience is instructive. Albania has offered 15-year fixed-price contracts for solar/wind through auctions, with prices around €50–70/MWh for solar. One could imagine an analogous approach where Albania tender for a certain amount of green hydrogen production and offers a fixed premium per kg. The level of that premium is essentially the subsidy. It might need to be on the order of several euros per kg initially to bridge the gap.

In terms of expectations, Albanian authorities likely foresee international funding covering the bulk of early hydrogen development costs, with the EU's support being pivotal. If hydrogen becomes part of Albania's EU accession commitments (for decarbonization), some state budget allocation could be justified as an investment in meeting those goals.

6.3 Planned support programs

Several programs and donors are already engaged or likely to be involved in supporting hydrogen-related initiatives in Albania. The European Union is arguably the most significant. Under the EU's Green Agenda action plan, specific initiatives around hydrogen are being introduced. The EU's Horizon Europe research program has opened some calls to "associated countries," including Albania, for clean energy innovation. Albanian researchers might partake in hydrogen research consortia. Also, the EU's Innovation Fund (which funds large-scale demonstration projects in low-carbon technologies) is accessible to companies in EU member states. The IPA (Instrument for Pre-Accession Assistance) funds have earmarked money for renewable energy projects in Albania (e.g., a solar farm in 2023). Future IPA rounds might explicitly allow hydrogen pilot projects.

The EBRD has shown keen interest via studies and is likely to support project implementation. They have a Green Economy Transition initiative that could provide both technical cooperation grants and actual investment in a bankable hydrogen project (EBRD could take equity or provide loans). The EBRD also often helps governments with policy. They might assist Albania in developing its hydrogen strategy or regulatory framework.

Germany's development bank KfW, and technical agency GIZ, are active in Albania's energy sector. Germany has a national hydrogen strategy that includes partnering with other countries to import green hydrogen. It's plausible that Germany may pilot a green hydrogen supply chain with a country like Albania, for example, KfW could fund an electrolyser and KfW or another German entity could take on the hydrogen (or ammonia) for import to Germany. GIZ could run capacity-building projects: e.g., training Albanian engineers on hydrogen safety, or conducting a detailed mapping of renewable sites for hydrogen production. Germany has launched the "H_2Global" initiative, a scheme to subsidize green hydrogen imports.

Aside from the EBRD and the World Bank, the European Investment Bank (EIB) is increasingly financing green hydrogen. They finance renewables and grids in Albania already. The EIB could lend to a public sector-led hydrogen project, like if Albania's state power company KESH decided to invest in an electrolyser at a hydro plant, the EIB might finance it at low interest.

The expectation is that virtually every hydrogen initiative in Albania in the near term will have donor or IFI involvement, given the high costs and Albania's limited resources. This is positive in that Albania can leverage international experience and funds, but it also means aligning with donor conditions and timelines. For instance, the EU may prioritize projects that improve regional integration (like cross-border hydrogen transport), so Albanian proposals that fit that mold may get preference in funding.

In summary, a cadre of international programs (EU, EBRD, KfW, etc.) is either underway or on the horizon to support hydrogen in Albania. Coordinating these – to ensure they cover all needs and don't overlap – will be important. Albania will benefit from this web of support, but it also needs to articulate its priorities to direct donor assistance effectively. The donors themselves are keen to showcase success stories of green hydrogen in developing contexts, so Albania has an opportunity to be a flagship if it seizes the moment with clear planning.

6.4 How the level of support was distributed

For support measures to be effective, they must be allocated across the entire hydrogen value chain – production, infrastructure, and end-use – ensuring that no segment becomes a bottleneck. This balanced distribution is a principal Albania will need to follow.

At present, because no significant hydrogen chain exists, support distribution is theoretical. But planning documents should allocate responsibilities and funding across ministries: e.g., "Ministry of Infrastructure and Energy to facilitate electrolyser investment via incentives; Ministry of Transport to facilitate adoption of hydrogen buses via subsidies; Ministry of Finance to allow tax breaks on hydrogen equipment," etc.

Additionally, the value chain includes human capital and R&D, which is sometimes overlooked. Albania should also invest in training engineers, first responders (for hydrogen safety), and researchers, possibly by creating university programs or joining EU research projects. This "soft" support ensures the value chain has the human resources needed.

7. DEVELOPMENT SCENARIOS

To gauge Albania's hydrogen future, it's useful to envision three scenarios – optimistic, neutral, and pessimistic – based on how key indicators evolve. The indicators of progress to watch include: expansion of renewable energy capacity (and how much is earmarked for hydrogen production), enactment of supportive policies (compliance with EU targets and effective national incentives), development of infrastructure (electrolyser capacity installed, number of H_2 refueling sites, any pipeline retrofits), and identification of off-takers (firm commitments by industries or transport fleets to use hydrogen).

7.1 Optimistic Scenario

In this scenario, strong political will and external support drive rapid hydrogen development. By 2030, Albania could have:

- *Renewable Capacity & Electrolysers*. A significant increase in solar/wind capacity well beyond domestic power needs, enabling surplus for hydrogen. For example, imagine 500+ MW of new solar and wind dedicated to hydrogen. Electrolyser capacity might reach 50–100 MW operational. This could produce on the order of 5,000–10,000 tons of green hydrogen annually, a substantial start. Major projects like the Saipem/Alboran hydrogen-ammonia plant in Fier would reach commissioning by the late 2020s, supplying both domestic needs and exporting ammonia.

- *Infrastructure & Off-takers*. At least 2–3 hydrogen refueling stations are built (e.g., in Tirana, Durrës, and perhaps a corridor toward Kosovo or North Macedonia), supporting a pilot fleet of dozens of fuel-cell buses and trucks. The Trans-Adriatic Pipeline company (TAP) might successfully test blending 5–10% hydrogen in the pipeline, allowing Albania to export some hydrogen to Italy as part of a regional scheme. Domestically, a partnership with a cement factory or refinery could see them using green hydrogen in their processes (with an off-take agreement for a portion of output from the electrolyser project). Albania could even become an exporter of green ammonia or methanol – for instance, shipping out several thousand tons of green ammonia per year to European buyers by ship from Porto Romano, leveraging EU demand for sustainable fertilizers and shipping fuel.
- *Policy & Compliance*. In this optimistic case, Albania meets and exceeds EU-aligned targets – e.g., achieves the 2030 transport RFNBO target with domestic hydrogen, not just certificates.
- *Regional Integration*. The optimistic path likely involves Albania becoming part of a Balkan Hydrogen Corridor – for example, linking with North Macedonia and Greece's emerging hydrogen projects (like North Macedonia's conversion of a coal plant to gas/hydrogen). This could allow pooling resources and access to a larger market.
- *Outcomes*: By 2030, hydrogen will still be a small fraction of Albania's energy mix, but it's visible and growing. Perhaps hydrogen accounts for a few percent of transportation energy (with some city bus fleets fully hydrogen, and trial heavy trucks running between Tirana and neighboring capitals). In industry, maybe 5–10% of the hydrogen feedstock needs (if any new ones arise) are met with green hydrogen. Crucially, investor confidence would be high, seeing Albania as a viable place for further hydrogen investments.

This optimistic scenario is contingent on multiple favorable factors: strong government commitment (providing land, easing bureaucracy), continuous donor financial support, successful early projects (no major technical or safety setbacks), and a stable regional security environment (so investors aren't scared off). In short, Albania becomes one of the Western Balkans' hydrogen leaders, capitalizing on its renewables and strategic location.

7.2 Neutral (Base-Case) Scenario

In a neutral scenario, progress is more modest and incremental. By 2030:

- *Renewables & Production*. Albania does expand solar and wind, but primarily to meet its growing electricity demand and reduce imports, with only a small portion going into hydrogen. Perhaps one medium-scale electrolyser (10–20 MW) is built, likely as a pilot/demonstration attached to a solar plant or a hydro dam. This could produce a few hundred tons of H_2 per year – enough to gain experience and supply a niche use.
- *Infrastructure & Use*. The neutral case sees at least one hydrogen refueling station in operation (like in Tirana) and possibly a second mobile or small station elsewhere. A handful of hydrogen buses (maybe 5–10) are in service in Tirana as a pilot for public transport, and a couple of logistics companies operate a few fuel-cell trucks for short-haul routes as a test (with heavy subsidy). There is no national hydrogen pipeline, but

small-scale distribution is done by tube trailers trucking compressed hydrogen from the production site to end-users within the country. No export of hydrogen or ammonia materializes yet – any hydrogen produced is used locally or not at all during low demand periods (maybe vented or the electrolyser is turned off if oversupply).

- *Policy & Targets.* Albania meets basic compliance with EU directives but possibly uses statistical transfers or imports of green fuel certificates to satisfy quotas (for example, importing some certified green hydrogen or e-fuel from the EU to formally meet the transport RFNBO target, if domestic production is insufficient). A hydrogen strategy gets adopted around 2026, but its implementation is slow, and much is left for after 2030. Some incentives are in place (e.g., import duty exemptions on hydrogen equipment and a time-limited operational subsidy for the pilot bus fleet). However, broad-based measures like carbon contracts or large-scale subsidies are not introduced, mainly due to budget constraints.
- *Market Dynamics*. In this scenario, there is interest from investors but also caution – one or two foreign-funded projects go ahead (maybe Fortis Energy builds part of its planned renewables but delays the hydrogen component until economics improve, or Saipem's project advances to FEED stage but awaits better market conditions to start full construction). Essentially, a few small wins occur. Albania gains experience with hydrogen tech, builds institutional capacity, and addresses initial regulatory hurdles. But the hydrogen economy remains in a pilot phase, not yet self-sustaining or scaling. By 2030, hydrogen usage in Albania is still minimal in the energy statistics – maybe fractions of a percent in transport or industry, but there's a foundation to build on.
- *Regional Role*. Regionally, Albania in the neutral scenario is a follower rather than a leader. Perhaps North Macedonia or Serbia might be slightly ahead with bigger projects, and Albania participates in regional knowledge exchange but hasn't built large export infrastructure. However, it stays engaged in the Energy Community initiatives, positioning for the next decade.
-

The neutral scenario effectively is business-as-usual with limited push – Albania does what is required and a bit more but doesn't fully capitalize on its potential yet by 2030. Hydrogen remains a niche, with the promise still mostly for the 2030s and beyond, assuming costs drop, and stronger policies can be afforded. Importantly, no major failure happens – the pilots go fine – but also no breakthrough in attracting huge investment occurs either. Public awareness of hydrogen might grow moderately due to a few buses or media coverage of the Bulqiza discovery, but it's not a mainstream part of the energy mix yet.

7.3 Pessimistic Scenario

In this case, progress on hydrogen in Albania stalls or only creeps forward very slowly, due to various potential setbacks. By 2030:

- Little to No Infrastructure. Albania might end up with no operational electrolysers of significant size – perhaps only a lab-scale demo at a university or a tiny 0.5 MW electrolyser installed as part of a donor project, which might be used sporadically. No dedicated hydrogen refueling stations have been built. Essentially, the country in 2030 looks much like 2025 in terms of hydrogen – still in the talk stage, with maybe a couple of feasibility studies done but no concrete hardware running.

- Policy Delays. A hydrogen strategy might be drafted but not officially adopted or adopted on paper but not implemented. Government priorities might shift elsewhere (perhaps the focus stays on conventional gas or just solar/wind without hydrogen). Regulatory gaps remain unaddressed – for instance, by 2030, Albania might still not have detailed safety codes or a guarantee-of-origin system for hydrogen. This would deter investors further, creating a vicious cycle of inaction. If the government perceives hydrogen as too costly or "for rich countries only," it may not allocate any budget or effort to it beyond lip service.
- Dependency on Imports for Compliance. To satisfy any EU renewable transport fuel requirement, Albania might simply import biofuels or buy green fuel credits from other countries, thereby doing the bare minimum for compliance without fostering any domestic hydrogen production. The transport and industrial sectors would remain entirely concentrated on conventional fuels (oil, gas) for lack of alternatives.
- Investor Apathy. In a pessimistic scenario, the exploratory projects by foreign investors could fall through. For example, suppose the natural hydrogen found in Bulqiza is determined to be unviable to extract cheaply, and interest fizzles out. Likewise, if the Saipem/Alboran and Fortis projects do not get needed support or offtake agreements, those MOUs may expire quietly without progress. Capital that might have gone to Albania's hydrogen finds more attractive destinations. By 2030, there might be no major foreign or domestic investment in hydrogen realized.
- Consequences. In this pessimistic timeline, Albania essentially misses the 2020s window to start its hydrogen industry. It enters the 2030s having to play catch-up under more pressure (as by then EU might impose stricter requirements or CBAM costs on anything produced with fossil fuels, potentially disadvantaging Albanian industry).

The pessimistic scenario could result from a combination of factors: lack of political will, economic difficulties (perhaps other urgent needs like post-pandemic recovery or rebuilding after natural disasters take precedence, squeezing out innovative projects), or a perception that hydrogen is too risky. It could also be triggered by an external factor like sustaining very low natural gas prices (making grey hydrogen cheap again, thus reducing global urgency for green hydrogen, though this is unlikely given climate imperatives). Essentially, Albania would, in this scenario, delay hydrogen development until maybe post-2030, possibly joining in only when forced by EU accession requirements or when technology is so mature that it becomes unavoidable.

8. RECOMMENDATIONS

To accelerate the development of a hydrogen economy in Albania and mitigate investment risks, the following multi-pronged approach is recommended:

1. Formulate and implement a national hydrogen strategy that establishes clear targets and timelines for hydrogen production and use. It should prioritize sectors such as transportation and industry, establish modest yet concrete goals for 2030, and identify strategic projects. The strategy must also align with Albania's broader energy and climate

plans (NECP) to ensure coherence. Once the strategy is in place, swift implementation is essential. Translate it into action plans, budget allocations, and monitoring mechanisms.

2. Strengthening the Regulatory and Legal Framework. Close the regulatory gaps by establishing the rules and standards for hydrogen. Introducing definitions for green hydrogen, hydrogen storage, etc., into energy legislation.
3. Setting up a Guarantee of Origin system for renewable hydrogen to certify its green credentials in line with EU standards.
4. Adopting technical safety standards for hydrogen production, transport, and refueling (possibly by directly transposing relevant EU standards or ISO standards).
5. Ensuring the new Gas Law (or amendments) explicitly allows hydrogen blending in pipelines and gives the energy regulator the mandate to regulate hydrogen networks.
6. Streamlining permitting. Designate hydrogen projects as strategic/priority investments to expedite environmental and construction permits. A one-stop shop for hydrogen project permitting could reduce bureaucratic delays.
7. Introducing Targeted Financial Incentives and Risk-Mitigation Tools. To jump-start investment, Albania should deploy specific financial support mechanisms.
8. Implement a contract-for-difference (CfD) or fixed premium scheme for green hydrogen production. This gives investors revenue certainly and effectively shares the market risk with the public sector.
9. Public co-investment or guarantees. The government can consider co-investing in strategic projects to show commitment and reduce perceived risk. Alternatively, the government could provide sovereign guarantees for loans taken by hydrogen project developers, so that banks are more willing to lend.
10. Insurance and safety-net mechanisms. Work with international partners to establish insurance for risks like technology performance or offtake default.
11. Offtake agreements and aggregation. The government can aggregate demand (e.g., commit the state-run bus companies and utilize to purchase certain amounts of hydrogen if produced domestically). Having public entities as anchor off-takers on long-term contracts can reduce demand risk for producers.
12. Foster Pilot Projects. Initiate one or more integrated pilot projects that demonstrate the entire hydrogen value chain on a small scale. The project should involve local academia for monitoring and optimization, building domestic know-how. International donors are keen to fund such “showcases”, so Albania should package and pitch a hydrogen valley concept to the EU or other funds. By executing a pilot, Albania will gather real data on costs, technical performance, and operational issues in the local context, informing larger projects. It will also train the local workforce (engineers, technicians, emergency responders) on hydrogen handling, which reduces human-capacity risk for future scale-up.
13. Encourage Regional Collaboration and Market Integration. Many of the hurdles (high costs, small market, lack of infrastructure) can be alleviated by working with neighboring countries. Albania should actively collaborate with Western Balkan neighbors and EU member states like Italy and Greece on hydrogen initiatives. Concretely:
14. Explore cross-border infrastructure opportunities. One idea is to use the existing TAP pipeline or plan a spur from it to transport green hydrogen produced in Albania to Italy or

the broader European network in the future. Albania can lobby for TAP to be included in European hydrogen backbone plans (TAP's operator, SNAM in Italy, is already testing H_2 blending).

15. Develop Human Capital and Public Awareness. So-called "soft measures" are very important. Train and educate the workforce on hydrogen technologies, for instance, set up specialized courses or certification programs at Albanian universities and technical institutes for hydrogen safety, electrolyser maintenance, and fuel-cell vehicle mechanics. Encourage student and researcher exchange with European institutions (leveraging programs like Erasmus+ or Horizon Europe partnerships) to build domestic expertise. Also, conduct public awareness campaigns about hydrogen's benefits and safety. Community engagement is crucial, especially if new infrastructure (like large solar farms for H_2 or transport of hydrogen) is planned. Early consultations can preempt opposition and incorporate local feedback. Additionally, fostering public-private partnerships, like hackathons or innovation challenges on hydrogen, can spur local entrepreneurship. Maybe Albanian startups could emerge in niche areas (like software for hydrogen plant control, or small-scale fuel-cell applications for rural areas). By investing in human capital now, Albania reduces one of the investment risks – the lack of skilled labor – and positions itself to capture more value domestically (not just importing all expertise).
16. Ensure Environmental and Social Safeguards. As hydrogen projects move forward, proactively address environmental and social considerations to avoid delays and opposition. Perform thorough but efficient EIA for projects and uphold high safety standards. Develop emergency response plans and train local fire brigades and first responders in handling hydrogen incidents, even if the probability is low. Also, plan the water supply for electrolysers wisely. By front-loading these safeguard measures, Albania can mitigate environmental risks and build a positive narrative around hydrogen.
17. Leverage External Funding and Private Sector Participation. Finally, align Albania's efforts to maximize access to international climate finance and private investment. For example, prepare bankable project proposals to submit to the EU's Innovation Fund, the Green Climate Fund, or other mechanisms. Don't wait passively for investors to come, but actively market Albania's hydrogen potential. Set up a facilitation unit (perhaps within the Albanian Investment Corporation or the respective ministry) that can assist and fast-track serious investors in hydrogen, guiding them through bureaucracy and connecting them with donors. Encourage public-private partnerships. The key is to reduce perceived risk for the private sector by sharing it (through the incentives and guarantees) and by demonstrating political commitment. A stable, transparent investment environment will attract companies that are currently scouting globally for the best locations to deploy their hydrogen tech.

In conclusion, **Albania stands at an early stage in its H2 journey**, but with strategic action now, it can accelerate towards a clean hydrogen economy. By setting a clear vision, enacting supportive policies, investing in pilots, collaborating regionally, and de-risking investments, Albania can harness its rich renewable resources to produce green hydrogen, creating new industries and jobs, bolstering energy security, and contributing to deep decarbonisation. The years up to 2030 are crucial. Proactive steps taken today will determine whether Albania becomes a frontrunner or a late adopter in the emerging hydrogen era. The recommendations above offer a roadmap to ensure Albania's hydrogen potential is realized, while building investor confidence through prudent risk-reduction measures and strong alignment with EU partners and standards. With careful implementation, Albania can turn hydrogen from concept into reality, positioning itself as a competitive player in the future clean energy landscape of EU.

SOURCES:

IEA, *Global Hydrogen Review 2024* – Hydrogen demand 97 Mt in 2023; low-emission H_2 <1 Mt.

Energy Futures Initiative (EFI) – SMR H_2 emits ~9 kg CO_2/kg H_2; coal gasification ~20 kg.

S&P Global – Gas price spikes made grey H_2 costlier than green in Europe in 2021–22.

KAPSARC/EFI – Oil refining (30–35%) and ammonia (38%) are top hydrogen-consuming sectors globally.

Clean Hydrogen Observatory (EU) – In Europe, refining uses ~4.55 Mt (57%) and ammonia 2.0 Mt (25%) of H_2[1].

Reuters – Western Balkans hydrogen developments: Serbia's 30 kt/yr H_2 plant by 2028; N. Macedonia H_2-ready pipeline with Greece.

National Geographic/Science – Natural "white" hydrogen discovery in Bulqiza mine, Albania (84% H_2, ~200 tons per year seep); reservoir estimated 5,000–50,000 tons H_2.

Tirana Observatory – Albania's renewable potential (high solar irradiance, wind) and need for energy diversification with green hydrogen for hard-to-abate sectors.

UNECE Interview – Need for Western Balkan hydrogen strategies and offer of support; the region could manufacture electrolyser components.

Albania Law No.24/2023 – Transposes EU RED II; sets 54.4% RES target by 2030.

S&P Global – Carbon Contracts for Difference recommended to bridge green vs grey H_2 cost gap.

Detajet/ SCAN zbardh studimin për depozitën më të madhe të hidrogjenit - Ekipi drejtohej nga 8 profesorë, mes tyre dhe 3 shqiptarë. - Shqipëria

Green Hydrogen in Albania's Energy Transition: A Techno-Economic, Environmental, and Strategic Assessment by Andi Mehmeti, Endrit Elezi, Armila Xhebraj, Ylber Bezo :: SSRN

1& 2 observatory.clean-hydrogen.europa.eu Homepage | European Hydrogen Observatory