

ATLANTIS HYDROGEN

Type: Interviewer-led | Difficulty: Medium | Function: Sustainability | Sector: Public Sector | Stretch areas: Structuring, Judgement & insights | Author: ex-McKinsey

Green hydrogen is expected to play a significant role in energy systems as countries move to clean energy sources to address climate change.

Atlantis is a country with abundant and highly competitive renewable resources in solar and wind. Our client is the Minister of Energy in Atlantis. They believe that Atlantis could become a major global supplier of green hydrogen for developed countries in Europe, the US and potentially Asia. They are interested in exploring what it would take to establish a green hydrogen economy.

The Minister of Clean Energy in Atlantis has approached us to understand how Atlantis can set itself up to successfully supply cost-competitive and abundant green hydrogen to the world over the next 5 years.

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ATLANTIS HYDROGEN – QUESTION 1

Dimension: Structuring

What are some of the critical elements that Atlantis should consider when assessing its potential for a green hydrogen economy?

ADDITIONAL INFORMATION

- Green hydrogen is an energy-rich fuel made by electrolyzing water using renewable energy, splitting it into hydrogen and oxygen molecules
- Hydrogen can be employed in many use cases, replacing fossil fuels (oil, gas, coal)
- Today, green hydrogen is an expensive fuel because of the immaturity of the technology. However, in the next 10-15 years, hydrogen is expected to be cheaper than alternatives (i.e., fossil fuels) as carbon taxes rise and technology prices for hydrogen production, storage and transport decline
- Due to its ability to be stored and transported, hydrogen can serve as a better foundation/baseload for power supply than other renewables which are variable and depend on the weather
- Countries with abundant flat/hilly land (i.e., not mountainous), water, sunlight and wind are attractive producers of green hydrogen

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ATLANTIS HYDROGEN – QUESTION 1

Dimension: Structuring

PROPOSED
SOLUTION

1. Can Atlantis produce hydrogen cost-competitively?
 - Is there sufficient and affordable access to inputs - water, solar/wind?
 - Is there sufficient and affordable access to technology (e.g., photovoltaic modules, turbines, electrolyzers)?
 - Is there sufficient and affordable access to capital resources (e.g., land, transmission infrastructure)?
 - Are there sufficient local skills and talent available, at a competitive cost and productivity?
2. Does Atlantis have access to markets for hydrogen?
 - Will there be a domestic market for hydrogen?
 - What is the demand for energy and its expected growth?
 - Are there cheaper alternatives produced locally?
 - How quickly can demand convert to hydrogen: transport, heating, manufacturing etc.
 - What is the export potential for Atlantis' green hydrogen?
 - What is the market size and growth of hydrogen and hydrogen-derived products (e.g. ammonia) in neighboring countries?
 - Can Atlantis deliver hydrogen to these countries at a competitive cost?
3. What are the supporting competencies needed, and what are the major risks?
 - Political will and supportive policy: regulations, licensing rights, tariff structures, access to intellectual property
 - Physical infrastructure: road links, railways, transmission lines
 - Risks (Changes in government, unexpected competition, loss of talent, alternative technologies emerging)

ATLANTIS HYDROGEN – QUESTION 2

Dimension: Math

Green hydrogen will be traded globally, so being cost-competitive is important. Atlantis doesn't need to be the absolute lowest-cost producer, since global demand will likely exceed supply. However, it must avoid being significantly more expensive than other countries competing in the market.

We have done some internal modelling to benchmark the landed cost of hydrogen from four hydrogen-producing countries, including Atlantis. We have looked at both production costs and shipping costs. *Share Exhibit 1.*

What would be the subsidy (as a %) that would be required to put Atlantis among the top 2 most cost-competitive producers of green hydrogen globally?

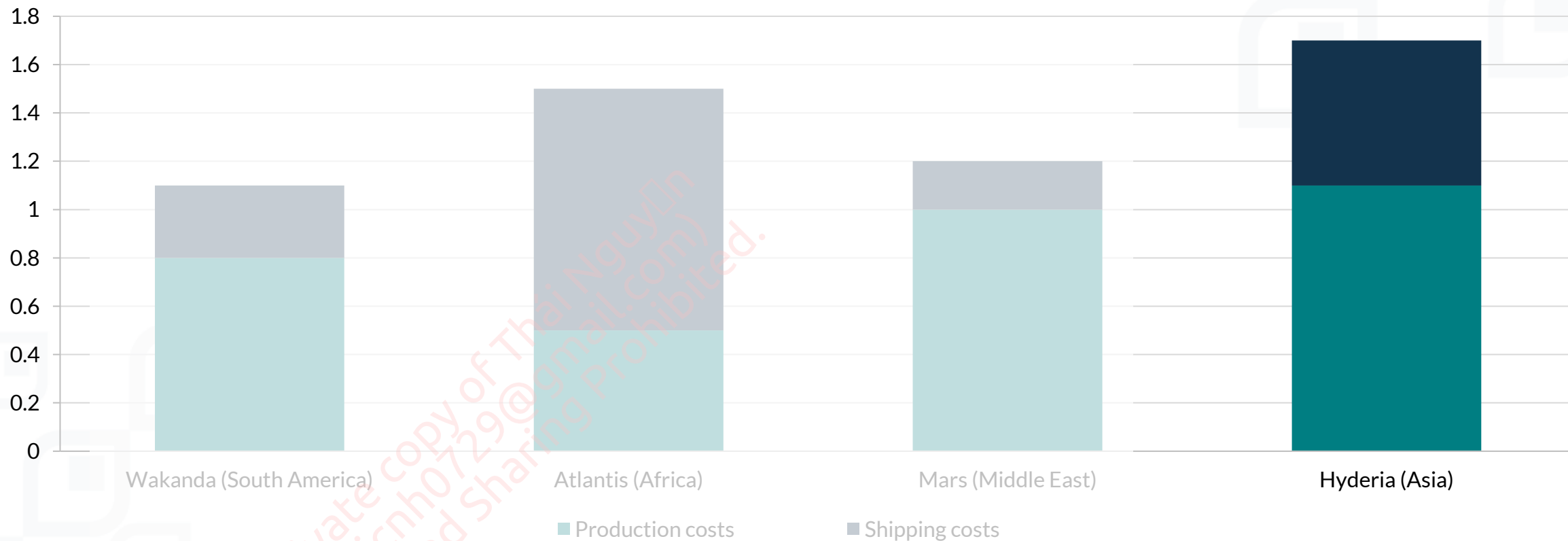
ADDITIONAL INFORMATION

Candidates should assume no other countries pay a subsidy.

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ATLANTIS HYDROGEN – EXHIBIT 1

GREEN HYDROGEN LANDED COSTS (\$/KG)



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ATLANTIS HYDROGEN – QUESTION 2

Dimension: Math

PROPOSED SOLUTION

- The subsidy required to be the second-most competitive supplier will be the % difference between Atlantis' current landed cost and the cost of the current second-most competitive producer.
- To match Mars's costs of 1.2\$/kg, the subsidy required is at least 20% (1-80%). This is because $1.5 * X = 1.2$, where X is the reducing factor needed to match Mars' costs. Therefore $X = 0.8$ (or 80%)
- If the government is prepared to provide a 20% subsidy, then Atlantis will be in the Top 2 most competitive producers of hydrogen.
- While a 20% subsidy would technically close the competitiveness gap with Mars, subsidies are vulnerable to retaliation and may not provide a lasting advantage.
- A more sustainable lever for Atlantis could be to address its disproportionately high shipping costs, which make up a large share of its landed price. Investments in port, rail, or next-generation shipping technologies could structurally reduce costs and deliver a more durable path to maintaining a Top-2 position in global green hydrogen markets.

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ATLANTIS HYDROGEN – QUESTION 3

Dimension: Creativity

Why might a government be prepared to pay a subsidy for green hydrogen production?

PROPOSED SOLUTION

- To help a new, promising industry get off the ground:
 - Predictable subsidies will encourage investors to establish the necessary infrastructure and supply chain
 - Once the sector is established, the country will develop skills and capabilities other countries don't have
 - The country will become competitive for further investments in the industry even after the subsidies end
- To stimulate national economic growth and prosperity:
 - Grow GDP
 - Improve the trade balance of the country (reduce import/increase exports)
 - Generate new tax receipts
 - Diversify the economy
- For national security reasons, by reducing industry imports/becoming energy-independent
- To improve the quality of life for citizens and residents:
 - Create new, high-quality jobs
 - Develop low-growth or under-developed regions (e.g., arid regions)
 - Improve infrastructures, such as roads/railways/ports, which can benefit other local industries

ATLANTIS HYDROGEN – QUESTION 4

Dimension: Judgement and insights

From the above, we have seen that Atlantis can produce green hydrogen competitively, but the landed cost is not necessarily competitive without intervention.

What could be driving their high shipping costs, and where would you focus your efforts if you were trying to reduce costs?

ADDITIONAL INFORMATION

Hydrogen can be transported in several ways. The cheapest is by pipelines, either retrofitted natural gas or new pipelines. This is only relevant for shorter distances. Alternatively, hydrogen can be converted into ammonia (which can be transported as a liquid at ambient temperatures and moderate pressures) in a process called ammonification, and then “cracked” again at the other end, or can be shipped as liquid hydrogen in highly specialized, pressurized tanks. These processes requires significant amounts of electricity.

INTERVIEWER GUIDANCE

Candidates are unlikely to consider the conversion costs, but interviewers could prompt by asking “How do you get the hydrogen gas into a state that allows it to be transported? What might be the associated costs of this?”

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ATLANTIS HYDROGEN – QUESTION 4

Dimension: Judgement and insights

PROPOSED SOLUTION

- Transport and infrastructure
 - High distance to reach consumers
 - Poor state of infrastructure (e.g., railways, highways, ports)
 - High fuel prices for shipping (e.g., fuel taxes or surcharges in Atlantis)
 - Outdated shipping technology
 - Lack of alternative shipping methods such as pipelines or rail for more conveniently located producers
 - High labor costs (e.g., drivers, port staff)
- Conversion costs
 - High costs of electricity to ammonify, compress or crack the hydrogen
 - High labor costs
 - Lack of technology and capital (e.g., to compress the hydrogen or convert it to ammonia)

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ATLANTIS HYDROGEN – QUESTION 5

Dimension: Synthesis

The Minister of Clean Energy just walked into our team room and would like to hear our recommendation on how to set Atlantis up to supply green hydrogen to the world over the next 5 years.

What would you tell them?

PROPOSED SOLUTION

You have asked us to determine what factors are important to consider when establishing a new green hydrogen industry in Atlantis. We've found that Atlantis has one of the most competitive production costs compared to other producing countries, but very high shipping costs. To match the landed costs of the second most competitive supplier, Atlantis will have to provide a 20% subsidy on landed costs. Providing a subsidy would help get the industry off the ground and could stimulate economic growth. However, the client should explore ways to bring down shipping costs, for example by tackling transportation and conversion costs. As next steps, Atlantis should explore new shipping technology investment opportunities, analyze the domestic and international market opportunities, develop supportive policies for the industry, including subsidies needed, and identify local skills gaps.

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