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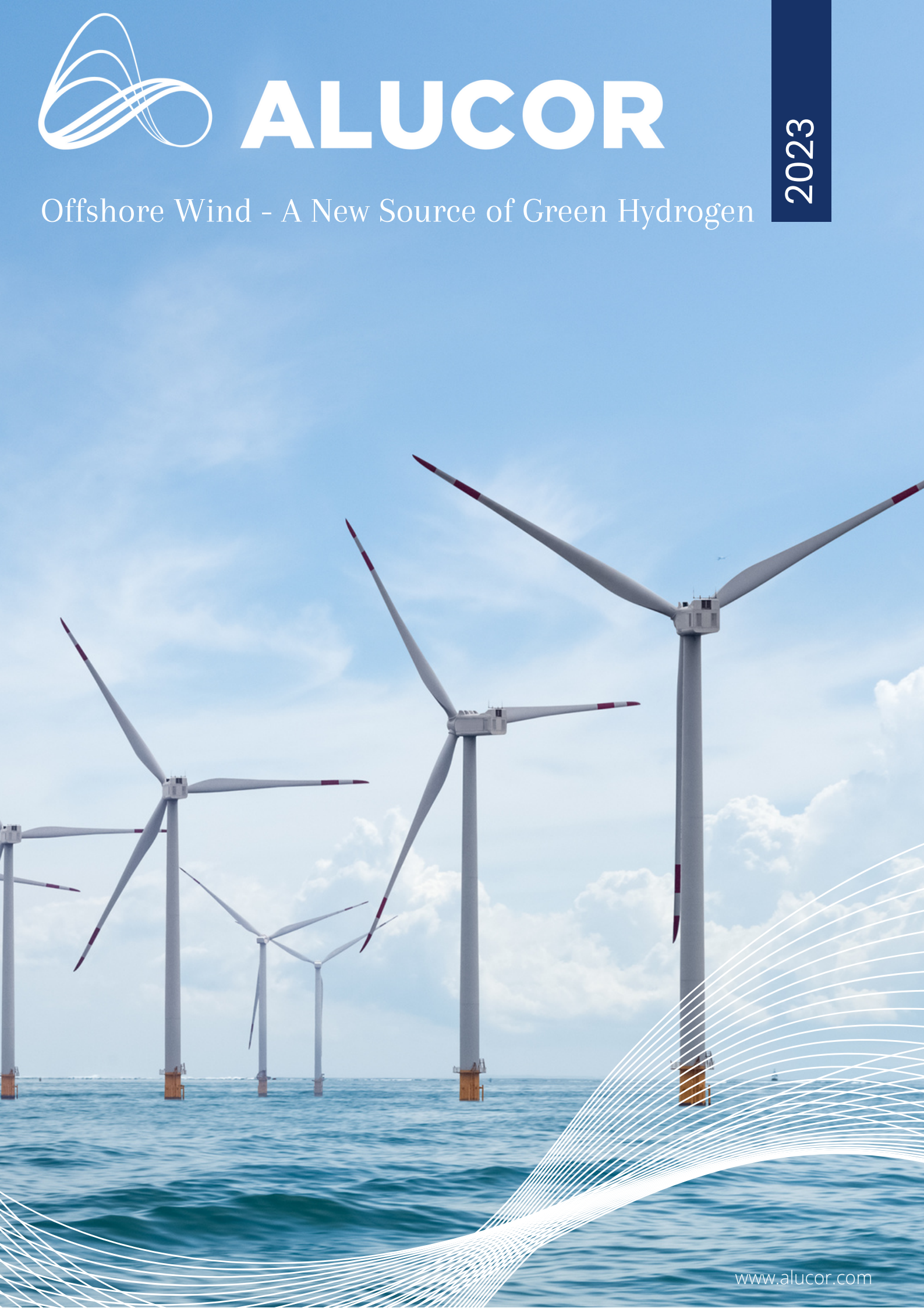
Offshore Wind - A New Source of Green Hydrogen



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Offshore Wind - A New Source of Green Hydrogen

Offshore wind farms are becoming an increasingly popular source of renewable energy, providing electricity to millions of people across the world. But what if we could do more with this energy? What if we could use it to produce a clean, sustainable fuel that could power everything from cars to industrial processes? This is where green hydrogen comes in.

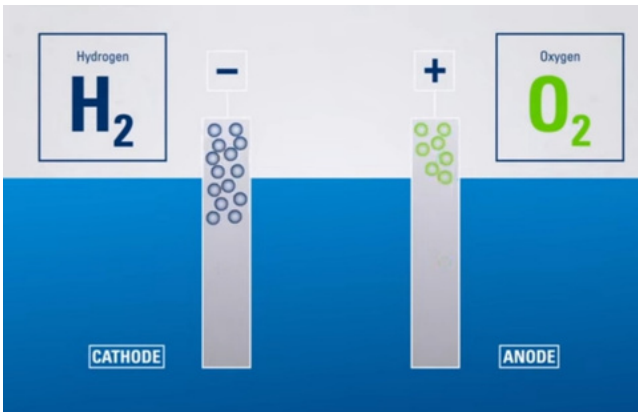


Figure 1: electrolysis explained, https://youtu.be/38ULHoKWZagI

INTRODUCTION:

Wind is an intermittent energy source, meaning that it is not always available when we need it. Wind turbines produce energy when the wind is blowing, but when the wind dies down, the turbines stop producing power. This means that wind energy alone cannot provide a reliable source of energy unless there is a way to store the energy for later use. This is where green hydrogen comes in. By using wind energy to produce hydrogen through electrolysis, the energy can be stored in the form of hydrogen gas and used when it is needed. This makes the energy more reliable and flexible, as it can be stored for longer periods of time and used to power a variety of applications.

Another advantage of producing green hydrogen from offshore wind farms is that it can provide a source of energy for applications that cannot be directly powered by electricity. For example, hydrogen can be used as a fuel for heavy-duty transportation like trucks and ships, as well as for industrial processes like steelmaking and ammonia production.

These applications require a high energy density fuel, which hydrogen can provide. Furthermore, producing green hydrogen from offshore wind farms can help to reduce the costs of offshore wind energy. One of the challenges of offshore wind energy is the high cost of building and maintaining the infrastructure required to generate and transport the electricity. By using the same infrastructure to produce hydrogen, the costs can be spread out over multiple revenue streams, making the overall cost of energy production more competitive.

Of course, there are still challenges to producing green hydrogen from offshore wind farms. The technology for producing and storing hydrogen is still developing, and the costs of building the necessary infrastructure can be high. However, as technology advances and the demand for clean energy continues to grow, the advantages of producing green hydrogen from offshore wind farms are becoming increasingly clear.

Few Facts:

Offshore wind power is difficult to integrate into existing energy systems, but green hydrogen produced by offshore wind could be a solution. A model has been proposed to determine the lowest cost of producing green hydrogen, which involves an integrated design of the hydrogen and offshore electric power infrastructure. The research shows that producing green hydrogen offshore could cost as low as 2.4 €/kg, which is competitive with natural gas. Installing an electrolyze offshore can also reduce the cost of wind electricity by up to 13%.

The Danish Parliament is building an artificial Energy Island in the North Sea to harness offshore wind power. It will connect 3 GW of offshore wind power plants and transmit electricity to shore at lower costs than individual offshore wind power plants.

Europe has set its sights on significantly expanding offshore wind power as a means of achieving a net-zero greenhouse gas emissions society. However, integrating massive amounts of offshore wind poses several challenges. One such challenge is the variability of wind power production, which can put the supply-demand grid balance at risk. Furthermore, the planned offshore installations require billions of euros worth of grid reinforcements.

Finally, electricity will face challenges with penetrating so-called hard-to-abate sectors, such as heavy-duty road transport, aviation, shipping, and the steel industry.

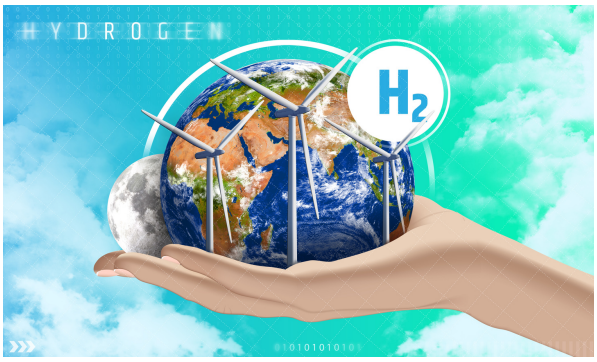
To address these challenges, water electrolysis, which uses green electricity to generate hydrogen, has emerged as a potential solution. Hydrogen can be stored for longer periods and in larger quantities than electricity, helping to balance the grid and avoiding grid reinforcements. It can also form the basis of green fuels like methane, ammonia, and methanol. The European Union has set a target to install 40 GW of electrolyzes in Europe by 2030, with an additional 40 GW in the EU's neighboring regions.

Offshore wind power has the potential to become a game-changer for hydrogen production. Recent studies suggest that offshore electrolysis using electricity generated from offshore wind farms can significantly reduce the cost of hydrogen production. While earlier studies indicated high costs, the declining cost and growing availability of offshore wind power make it a promising energy source for large-scale hydrogen production.

According to experts, the cost of producing hydrogen using a 100 MW wind farm-powered electrolysis plant in Norway is estimated to be around 5.2 €/kg. Meanwhile, studies conducted in the Dutch continental shelf of the North Sea found that producing hydrogen on existing oil and gas platforms could cost approximately 2.84 €/kg. However, if the savings from avoiding grid extensions are taken into account, the cost of producing 100% of a wind farm's power as hydrogen could drop to 1-1.75€/kg.

Another study found that producing hydrogen offshore and transporting it through a new pipeline is the most expensive option, with a cost of 6.4 €/kg. Nevertheless, this approach has the best CO2 equivalent emission performance.

While the cost of producing hydrogen and electricity from a multi-GW offshore energy hub has not yet been assessed, many experts believe that offshore wind power and hydrogen production could significantly contribute to achieving a net-zero greenhouse gas emissions society.



Potential locations for the electrolyser: onshore, offshore, and in-turbine

In the onshore scenario, electricity generated by offshore wind power plants (OWPPs) is collected at a hub and transmitted to shore. Hydrogen is produced using a single electrolyser, and the resulting hydrogen is compressed to grid pressure.

In the offshore scenario, the electricity produced by all OWPPs is transmitted to the hub, where a single electrolyser produces hydrogen using desalinated seawater. The hydrogen is then compressed and transported to shore through a pipeline.

In the in-turbine scenario, the electrolyser and desalination units are located inside or adjacent to the tower of each wind turbine. Produced hydrogen is transported to the hub via pipelines connecting groups of turbines. At the hub, the hydrogen is collected, compressed, and transported to shore through a pipeline.

DID YOU KNOW?

The earliest known use of electrolysis was by the English chemist and physicist Michael Faraday in 1833. He discovered that by passing an electric current through a solution containing ions, the ions would be attracted to the opposite electrode and could be separated from the solution.

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Conclusion:

Producing green hydrogen from offshore wind farms can provide a reliable and flexible source of energy that can be used to power a variety of applications. By using wind energy to produce hydrogen, we can store the energy for later use and reduce greenhouse gas emissions. And by using the same infrastructure as offshore wind energy, we can reduce the costs of energy production and make clean energy more competitive.

At Alucor, we work together with our partners to leverage our collective skillset gained from diverse sectors, enabling us to enhance our portfolio and provide optimal solutions for our clients. Our experience ranges from high pressure tanks to refineries and desalination plants to offshore wind projects. This breadth of industry experience has garnered positive feedback and established us as a leading provider of turnkey EPCI solutions.

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