

Cipher Neutron

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Cipher Neutron Achieves Breakthrough Efficiency with its AEM Electrolyser Stack

Toronto, ON--(June 19, 2024). Canadian company Cipher Neutron Inc. (“Cipher Neutron”, the “Company” or “CN”) is pleased to announce a significant milestone in the exponentially growing global green hydrogen production industry.

Cipher Neutron’s research and development department has achieved the unprecedented 94.36% efficiency on its Anion Exchange Membrane (AEM) electrolyser stack. This groundbreaking advancement promises to significantly reduce the cost of green hydrogen, making green hydrogen a more viable and sustainable energy source.

With this new accomplishment of efficiency, Cipher Neutron’s AEM electrolyzers now require only 41.754kWh to produce 1 kilogram (kg) of hydrogen. While this figure does not include purification losses, which are typically less than 3kWh per kilogram, ensuring that the overall energy requirements remain impressively low. This efficiency is measured at the stack level, considering the high heating value of hydrogen at 39.4kWh per kilogram. These results were produced under thorough industry standard analysis and are repeatable, ensuring reliable performance.

Reducing the Cost of Green Hydrogen

The increased efficiency of Cipher Neutron's proprietary AEM electrolyser stack translates directly into lower production costs for green hydrogen. Here is how:

- **Lower Energy Consumption:** By reducing the energy required to produce hydrogen, operating costs are significantly decreased. The high efficiency means that less electricity is needed, which is a major cost component in hydrogen production.
- **Operational Savings:** The advanced efficiency reduces wear and tear on equipment, leading to lower maintenance costs and longer operational life of the electrolyser systems.
- **Enhanced Productivity:** Higher efficiency means more hydrogen is produced per unit of energy consumed, increasing overall productivity and output without the need for additional energy input.
- **Competitive Pricing:** With reduced production costs, Cipher Neutron can offer green hydrogen at a more competitive price point, making it an attractive alternative to fossil fuel based hydrogen and other energy sources.

- **Scalability and Investment:** The cost savings associated with the increased efficiency make it more feasible to scale up large volume hydrogen production, attracting more investments and accelerating the adoption of green hydrogen in various industries.

Repeatable and Scalable Efficiency

Cipher Neutron's breakthrough in achieving 94.36% efficiency is not only a singular achievement but also repeatable and scalable. This ensures consistent performance and reliability across different production scales, from small pilot projects to large industrial applications. The technology's scalability makes it ideal for widespread adoption, meeting the growing global demand for sustainable energy solutions.

Key Contributing Factors

Cipher Neutron's remarkable efficiency achievement is the result of several proprietary innovative design and manufacturing advancements:

- **Unique Flow Fields Design:** Ensures the optimum flow of electrolyte within the system and the timely evacuation of gas, reducing energy losses and enhancing overall efficiency. This design optimizes the distribution and circulation of the electrolyte while efficiently managing the produced hydrogen and oxygen gases. Timely removal of produced hydrogen ensures there is no trapping of gas within the stack and electrolyser system, utilizing the full active surface area of the stack cells and maintaining uniform performance across the electrolyser stack.
- **Proprietary Ink Recipe and Coating Mechanism:** Enhances the electrochemical performance and durability of the electrolyser components. The unique ink recipe of Cipher Neutron combined with CN's in-house developed coating mechanism ensure that the catalyst penetrates the substrate effectively, ensuring that the catalytic material is deeply integrated into the structure of the electrodes. This catalyst penetration is crucial for achieving high conductivity and maximizing the reactive surface area. Additionally, the even and uniform coating provided by the unique CN mechanism enables uniform performance across the entire electrode surface, preventing hotspots and ensuring consistent efficiency.
- **Advanced Cell Compression Techniques:** Improves contact efficiency and reduces resistance. Proper compression ensures that all components within the cell are in optimal contact, reducing electrical losses and improving the overall energy efficiency of the system.
- **Zero-Gap Cell Technology:** Minimizes the distance between electrodes of the stack, leading to higher efficiency. By reducing the physical distance or gap between the electrodes, the system experiences lower resistance and higher reaction rates, which contribute to the overall efficiency.

Challenging Grey Hydrogen Prices

Achieving high efficiency is essential for green hydrogen to compete with grey hydrogen, which is produced from natural gas and is currently less expensive due to established, lower-cost carbon-

emitting production methods. Cipher Neutron's advanced AEM electrolyser stack, with its 94.36% efficiency, reduces the energy needed to produce hydrogen, significantly lowering the production costs. This makes green hydrogen more economically competitive and attractive, aligning with global efforts to reduce carbon emissions and transition to sustainable energy sources.

Uniqueness of Cipher Neutron's Electrolysers

Cipher Neutron's AEM electrolysers stand out in the electrolyser industry not only for their high efficiency but also for their unique and sustainable design. The CN electrolysers are PFAS-free, eliminating the use of harmful Perfluoroalkyl and Polyfluoroalkyl Substances, which are persistent environmental pollutants. Additionally, the CN electrolysers do not require iridium, a scarce and expensive material that poses a significant supply chain constraint for other major electrolysis technologies. These factors make Cipher Neutron's products both environmentally friendly and cost-effective. Furthermore, the Company has maintained high current densities of 1.1 amps per cm² at these efficiency levels, ensuring a compact design and efficient use of space and materials.

Comparison to Traditional Electrolyser Systems

Traditional electrolyser systems typically require 50kWh to produce 1 kilogram of hydrogen. In comparison, Cipher Neutron's AEM electrolyser stack now requires only 41.754kWh, representing an improvement in energy consumption of almost 19.75%.

To illustrate the cost savings at scale, consider a 100MW project:

1. Traditional Industry Standard Green Hydrogen Electrolyser Stack:

- Energy required per kg of hydrogen: 50kWh
- Annual hydrogen production (assuming 100% capacity, 8760 hours/year):

$$100,000\text{kW (100MW)} \times 8760 \text{ hours} / 50\text{kWh/kg} = 17,520,000\text{kg}$$

2. Cipher Neutron's AEM Stack:

- Energy required per kg of hydrogen: 41.754kWh
- Annual hydrogen production (assuming 100% capacity, 8760 hours/year):

$$100,000\text{kW (100MW)} \times 8760\text{hours} / 41.754\text{kWh/kg} = 20,980,026\text{kg}$$

3. Cost Savings by using Cipher Neutron's AEM Technology:

Using the same amount of energy, Cipher Neutron's AEM Electrolyser will produce an additional 3,460,026kg of green hydrogen annually compared to the industry standard, resulting in a total of 20,980,026kg from CN's electrolyser versus 17,520,000kg from the industry standard. This represents an increase of almost 20% more green hydrogen, which can help lower the cost of green hydrogen. The excess hydrogen can be used to produce

19,548 metric tons of green ammonia or 69,200 metric tons of green steel, significantly reducing global carbon emissions.

Large-Scale Benefits

The improved efficiency of Cipher Neutron's AEM electrolyser stack not only reduces the cost of green hydrogen production but also has significant implications for large-scale hydrogen projects. For instance:

- **Increased Plant Output:** With the efficiency improvement, a 100MW plant can produce approximately 20% more hydrogen annually, significantly increasing the plant's output and revenue potential.
- **Investment Attraction:** Lower production costs and higher output make green hydrogen projects more attractive to investors, facilitating the growth and expansion of the hydrogen economy.
- **Sustainability Goals:** Increased efficiency and reduced costs align with global sustainability goals, promoting the adoption of green hydrogen as a cleaner alternative to fossil fuels.

Ranny Dhillon, Chief Scientific Officer of Cipher Neutron, stated "Our team's dedication to pushing the boundaries of technology has led to this significant breakthrough. We are excited about the potential impact this will have on the green hydrogen market and our continued commitment to sustainability and innovation."

About Cipher Neutron Inc.

Cipher Neutron is a rapidly growing disruptive technology company focused on AEM Electrolysers for Green Hydrogen production and Reversible Fuel Cells for power generation and Energy Storage Solutions. Cipher Neutron is a global group of scientists, engineers, technology developers, experts in hydrogen technology, investment bankers and people that have worked in hydrogen for decades. Cipher Neutron's innovative products, such as AEM Electrolysers and Reversible Fuel Cells have unique advantages over other Green Hydrogen production, power generation and energy storage solutions currently available in the global market. Please see: <https://cipherneutron.com>

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