

**Battolyser – lowest
cost and only true
green hydrogen**

Imagine... Always Clean Energy

We envision a world in which most energy comes from renewable sources such as solar and wind. To realize an affordable energy transition with a secure energy supply, we need to minimize short-term energy losses and achieve the lowest long-term energy costs. This requires solutions for the growing imbalance between power supply and demand, with green hydrogen for sectors that are harder to electrify, such as industry and heavy transport.

Battolyser is the world's first integrated battery electrolyser system. The patented technology produces a highly efficient electrolyser that can also store and supply power like a battery. The system has the flexibility to follow the most volatile power markets and is scalable – and made from only abundant and recyclable materials. All in all, Battolyser offers the lowest cost and only true green hydrogen.



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"We need solutions to deliver the scale of the energy transition all the way to net zero. This means full integration with intermittent renewable energy sources, secure supply chains, and sustainable material use. Work back from a sustainable net zero world and invest in the lowest cost solution and true green hydrogen."

MATTIJS SLEE
CEO - BATTOLYSER SYSTEMS

Only the lowest electricity cost can achieve the lowest hydrogen cost

Affordable hydrogen from renewable sources is expected to account for 20% of Europe's energy system by 2050. Electricity is the dominant cost in the levelized cost of hydrogen. Trading power in volatile power markets and only producing hydrogen using low-cost power at high efficiency reduces the overall electricity cost the most. The lower the cost of hydrogen, the more economical and faster the energy transition.

What makes Battolyser unique?

Battolyser's low-cost hydrogen comes from a combination of eight elements: maximum operating range, high conversion efficiency, long product lifetime, very high uptime, low-cost raw materials, secure supply, ability to always sell your energy, and producing nothing but the most valuable true green hydrogen. All this makes our technology unique.

1. Operating range - Battolyser is the only electrolyser with an operating range that goes below 0%. Not only can you turn the system down to zero to prevent producing hydrogen from expensive non-renewable energy; you can even revert it and sell power back to the grid. In an off-grid situation, this means you can temporarily continue hydrogen production, even when no power is available.

2. Conversion efficiency - Battolyser offers unprecedented system efficiency of up to 85% at 30 barg outlet pressure. Save money on the largest cost component of green hydrogen, which is power, and produce up to 20.5 kg pressurized hydrogen per MWh of energy input.

3. Product lifetime - Battolyser uses proven stable nickel and iron electrodes, which are not subject to electrochemical degradation that reduces the efficiency and expected lifetime – common in conventional electrolysers. The low operating temperature and alkaline electrolyte also ensure benign conditions and offer increased stack longevity.

4. Very high uptime - Your Battolyser is always running. Mostly as an electrolyser, periodically as a battery selling power to the grid. This complementary use creates value beyond a separate battery and electrolyser system combined.

5. Low-cost raw materials - Battolyser uses only iron and non-battery grade nickel electrodes, which are both abundant low-cost raw materials. The rest of the system also uses low-cost materials, due to the low temperature and alkaline environment, resulting in a much more affordable system overall.

6. Secure supply - Battolyser systems are made from abundant raw materials based on robust supply chains required to meet the scale of an independent energy transition.

7. Robust to market charges - When energy prices are high, it may be more attractive to sell stored power rather than producing hydrogen. If the offtake of hydrogen is interrupted, Battolyser can generate value as a battery. It is a no-regret asset that lets you arbitrage between hydrogen and power markets.

8. Always green - Europe's Renewable Energy Directive (RED) provides valuable credits for hydrogen produced from additional, local and time-correlated renewable sources. Battolyser's inherent flexibility allows you to follow any renewables load curves, comply with the strictest rules for temporal correlation, and produce nothing but true green hydrogen.

Only true green hydrogen counts

At Battolyser Systems, we do not just want to produce the lowest cost hydrogen; we also want to be the most sustainable solution. For us, sustainable means the use of fully recyclable materials (no PFAS), minimizing energy losses and maximizing the use of renewable energy.

Why is Battolyser the most sustainable?

Renewables only - Battolyser allows you to use electricity from exclusively renewable sources. It is flexible enough to follow any renewables load curve and accurately adjust production to the renewable power available. And it can instantly shut down or even sell electricity back to the grid if the supply of renewable energy stops, and immediately restart production when the supply becomes available again.

Less energy - Battolyser offers very high system efficiency, producing hydrogen at pressure and requiring far less energy than conventional technologies.

Longer product life - Battolyser uses nickel and iron electrode materials in a benign operational environment. These nickel-iron batteries are robust and have been in use for decades.

Green energy storage - When there is a shortage of renewable power, Battolyser can pause hydrogen production and sell stored renewable energy back to the grid.

More renewable energy developments - Battolyser can improve the business case for integrated renewable energy developments. It can even lead to new renewable energy developments as it helps to alleviate congestion.

Low lifecycle footprint - Battolyser consists of components designed to be replaced, with PFAS-free materials that are easy to recycle at end of life.


Real-time usage - Being truly green means using renewable power at the same time it is produced, or directly connected. And that's exactly what Battolyser does; our technology can follow any locally produced renewable energy supplies and comply with the strictest rules for temporal correlation.

#truegreen





 **Battolyser Systems**

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CONCEPTUAL VISUALIZATION,
ARTIST'S IMPRESSION

Applications

A Battolyser system offers both electrolysis and energy storage capabilities, making it the ultimate flexible solution in volatile power markets, and offering independent operations in off-grid installations. Grid-connected Battolysers can arbitrage between power and hydrogen markets to achieve the lowest cost hydrogen. Off-grid Battolysers can be shut down when there is no renewable power source available, and offer an uninterrupted power supply, even allowing hydrogen production from stored electricity.

GRID-CONNECTED HYDROGEN PRODUCTION

To decarbonize the industry, we need affordable and baseload green hydrogen. Battolyser can offer the lowest cost hydrogen by selling stored electricity when power prices are high, and producing hydrogen efficiently when prices are low. It can produce low-cost green hydrogen in the short term to blend in with grey hydrogen streams. In the longer term, Battolyser can produce low-cost hydrogen into pressurized pipeline networks with large storage capacities and hydrogen imports.

ISLAND-MODE HYDROGEN PRODUCTION

An off-grid solution requires independent operation. Conventional electrolyzers need a battery to keep operating at minimum load and for uninterrupted power supply. Battolyser has no minimum load requirements and can adapt to any renewable power load curve. The system can be shut down when there is no renewable power, provide stored power services for other facilities, or temporarily continue hydrogen production even when there is no renewable power available.

GRID BALANCING

Unlike batteries that fill up quickly, and traditional electrolyzers that cannot easily be shut down or even operate below minimum load, Battolyser sets itself apart as 'a battery that cannot fill up with an electrolyser that can operate as flexibly as a battery.' It can provide power to the grid when there is a shortage and take from it when there is a surplus. This grid balancing improves hydrogen sales margins and the business case for Battolyser asset owners.

RENEWABLES EXPANSION

Renewable energy expansion requires a well-balanced grid. Integrating Battolysers into the energy system can prevent the need to curtail renewables, alleviate grid constraints, and improve the business case for more wind and solar projects. In short, it allows for faster and more renewable energy developments.

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PRODUCT SHEET



The versatility of green hydrogen makes it an attractive solution for reducing greenhouse gas emissions across various sectors. There is a wide range of potential applications, including industry and transportation.



CHEMICAL FEEDSTOCK

Green hydrogen can be used as a chemical feedstock for industries currently using grey hydrogen, such as ammonia (fertilizers), methanol, refined oil products and specialty chemicals. It will also displace fossil feedstocks in industries such as steel and cement moving forward.



INDUSTRIAL PROCESSES

In industrial processes that are hard to electrify because of the heat required or a limited energy supply, green hydrogen can be the zero-carbon alternative for fossil fuels. Battolyser can produce hydrogen onsite and balance your power needs.



STORAGE AND IMPORT

Green hydrogen can store renewable energy for import into regions with an energy shortage and for local, seasonal energy imbalances. Liquefied or bonded hydrogen (ammonia and methanol) can be imported from regions with lots of renewable energy. Compressed hydrogen can be stored in underground caverns connected to pipeline systems.



TRANSPORTATION

Long-haul heavy-duty transport such as aviation, shipping and haulage needs to carry large amounts of energy for their journeys. Hydrogen is the base component for all these fuels.

A future-proof investment

European Union (EU) regulations are being put in place to achieve a net zero and more energy independent Europe. The electrolyser market is still in its infancy; products available today are not suitable for the scale of the energy transition. Battolyser is currently the only technology available that complies with EU regulations and has no intrinsic limitations to scale. Choosing Battolyser is investing in a technology that can scale with your future portfolio needs.



Regulation compliancy

Renewable Energy Directive (RED II)

RED II has set new targets for the use of renewable energy in the EU, including the use of renewable energy sources for hydrogen production. In addition to defining the criteria for green hydrogen, it also provides valuable credits for 'true green' (RED II compliant) hydrogen used in Europe.

Hourly matching will be mandatory from 2030, which means that credits will only be available for operators who generate hydrogen in the same hour as the renewable electricity was produced or from stored renewable energy.

Battolyser is a flexible system that can produce true green hydrogen only when renewable power is available. Where conven-

tional electrolysers need high load factors leading to high power cost, Battolyser can pick only the cheaper hours of the day to produce RED II compliant hydrogen.

Net Zero Industry Act

The objective of this Act is to build a European industry for energy transition critical infrastructure. The regulation aims to create net zero projects with European supply chains within Europe. More specifically, it targets that 40% of the electrolysers needed to achieve the REPowerEU plan must be manufactured within the EU.

Battolyser Systems is compliant with the Net Zero Industry Act, and we are committed to manufacturing the Battolyser with the value chain in Europe.

Critical Raw Materials Act (CRM)

The CRM ensures that Europe has access to a secure and sustainable supply of critical raw materials essential for meeting its 2030 climate and digital objectives. The Act prevents over-reliance on any one nation, with a cap of 65% for a strategic raw material anywhere throughout its value chain.

Battolyser complies with the CRM as it relies on iron and non-battery grade nickel, which are abundant and widely available from different sources.

REPowerEU: "The European Commission ambition is to produce 10 million and import 10 million tonnes of renewable hydrogen in the EU by 2030."



At a glance

Only solutions that can be fully integrated with intermittent renewable energy sources, with secure and sustainable supply chains, and which use materials that are environmentally responsible, can achieve the scale and scope needed for the energy transition. We need true green hydrogen to decarbonize hard-to-abate sectors such as heavy industry and transport to get to net zero. By investing in true green hydrogen solutions now, we can get net zero faster and at lower cost.



Efficient



Flexible



Scalable

Lowest LCoH



Reduce power need, the dominant cost of hydrogen, with high system efficiency of up to 85%.

Reduce power cost, by always arbitraging between producing hydrogen and selling power. Only converting low-cost power to hydrogen.

Very high load factor, making optimal use of capital investment.

True Green



Less waste and more hydrogen from available renewable energy sources due to high system efficiency.

Lower cost value chains, due to high overall system efficiency, requiring less renewable energy sources to be developed.

Sell power when prices are high and produce hydrogen when prices are low.

Generate valuable credits, by maximizing RED II compliant hydrogen production.

No need for fossil back-up, by following any renewables load curve and adjusting production to what is available.

Alleviate grid congestion, by selling power when there is a shortage and only buying surplus power.

Long lifetime, as materials used do not have harsh degradation environment.

Use of abundant and low-cost materials, allowing secure and scalable supply chains.

Low material footprint, materials used are easy to recycle (no PFAS).

Supports more renewable energy developments, by integrating in congested grids.



Why choose us?

If you are developing a green hydrogen portfolio, you need a technology that provides the lowest levelized cost of hydrogen, is capable of following any renewable load curve, and is scalable without supply chain constraints. Only a Battolyser can offer the lowest cost and true green hydrogen.

Invest in technologies that can meet the scale of the energy transition all the way to net zero. Battolyser is now available to support achieving this goal.

LOWEST HYDROGEN COST

Battolyser is the system with the lowest power cost thanks to its high efficiency and ability to arbitrage between selling power and producing hydrogen.

TRUE GREEN HYDROGEN

Battolyser is made from sustainable materials only and has the unique capacity to produce true green hydrogen, following intermittent renewable energy production.

SCALABLE SUPPLY CHAIN

Battolyser Systems is the only EU compliant electrolyser OEM, ensuring strict adherence to RED II value with no dependence on critical raw materials, and 'made in Europe'.

Battolyser® is a registered trademark of Battolyser Systems.



Battolyser Systems

Conradstraat 4
3125 BC Schiedam
The Netherlands

info@battolysersystems.com
+31 10 4739273