THE STRONGEST LINK.

STAHL

THE GREEN LINK: PROTECTING NEW ENERGY

Explosion protection for the H_2 supply chain

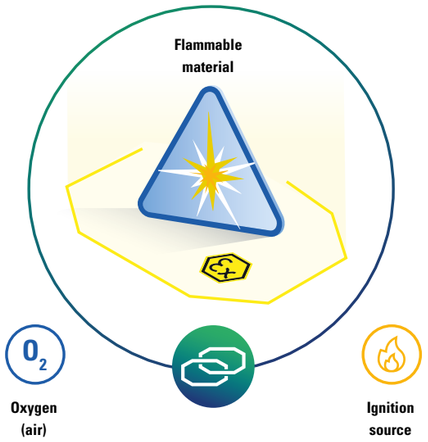
NEW ENERGIES, NEW HAZARDS.

Hydrogen energy may be clean and powerful, but it's not without hazards. H_2 requires a very low level of energy to ignite – in fact, only a tenth of the energy that gasoline needs. It burns extremely hot, with a flame that's invisible to the human eye. It also combusts extremely quickly, building up enormous explosive energy. That's why hazardous areas where technical precautions can be found in any location where Hydrogen is present – whether it's being made, transported, stored or used.

In some cases, the transition from a traditional fuel to Hydrogen only changes the type or severity of an already existing hazardous area. We can help by revising all existing safety infrastructures for the special requirements of Hydrogen, such as its volatility and aggressive corrosivity. In other cases, however, implementing Hydrogen-based technologies will create hazardous areas where

there weren't any before – requiring a partner with considerable experience in building bespoke explosion protection systems for any possible application. And that's just what we do.

R. STAHL has the technologies that prevent Hydrogen from being a hazard, the certifications to install them around the globe, and the know-how to customise any solution to your precise requirements, whatever they may look like. So go ahead and make the world green. We'll be there to support you and make it safe.



An explosion can only occur if a combustible material comes into contact with oxygen and an ignition source. H_2 requires a low level of energy input to ignite, combusts very fast and burns extremely hot, with a flame that's invisible to the human eye.

MAKING HYDROGEN HAPPEN. BUT NOTHING ELSE.

Renewable energies such as wind and solar are a key driver of any vision for a net-zero future. But the sun also sets and there are times when the wind doesn't blow. Because energy demand doesn't follow the cycles of nature, there's an obvious need to store electrical energy when we can create more than we use – for later, when demand is high and production is low.

One way is to produce Hydrogen with this excess energy in a process with potentially little to no carbon footprint, depending on the method chosen. There is a number of ways to turn green electricity into green Hydrogen, and there are thousands of applications for a green energy carrier.

But they all have something in common: a need for specialised equipment that neutralises the extreme explosion hazard of elemental Hydrogen.

That's where we come in. Our advanced explosion protection technologies are built to last, with a portfolio that covers the entire H_2 value chain and any imaginable use case: from Hydrogen production plants, through storage and transportation tanks, all the way to fuel cells and other applications for downstream industries and end users.

PROTECTING THE H_2 SUPPLY CHAIN.

Every year 600 billion cubic metres of Hydrogen are used worldwide.

PROTECTING THE SOURCE

Hydrogen can be produced in several different ways, the main ones being electrolysis of water atoms ($2\ H_2O \rightarrow 2\ H_2 + O_2$) and steam reforming of natural gas ($CH_4 + H_2O \rightarrow 3\ H_2 + CO$). But no matter which method is used, one thing that all production sites have in common is a lot of freely available Hydrogen that needs to be handled with special care throughout the entire process. R. STAHL supports Hydrogen producers with expertise in systems design, consultancy and maintenance services.

PROTECTING THE JOURNEY

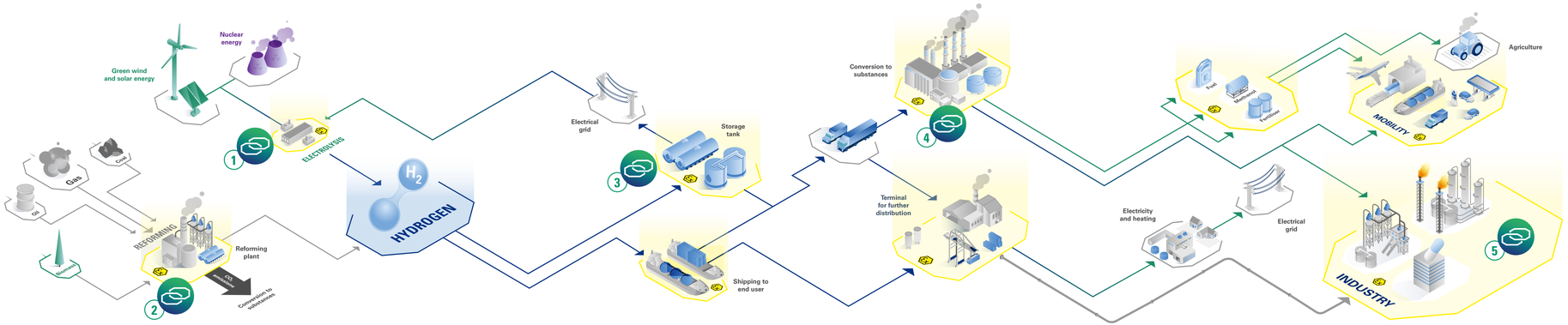
Hydrogen provides a great way to store energy, but stored energy needs to get to where it's needed – that is, a million different places around the globe that all need it in different ways. But whether it's being fed into the power grid when there's no sun or wind to drive renewables, or whether it's ultimately bound for commercial use by end users, either for businesses or consumers, it needs to be guarded every step of the way to make it safe along the entire path. R. STAHL supports Hydrogen distributors with wide-ranging experience in transportation, storage and conversion.

Hydrogen can be transported in tanks or through pipelines, if the demand is high enough.

The three main end users of Hydrogen are the industry, mobility and supply sectors.

PROTECTING THE ENDPOINT

Most of the Hydrogen produced today is used by industries that understand explosion hazards as a matter of course. However, this is changing as H_2 makes headway in "the real world" and starts being used in places like steel mills. But less extreme places also need to think about safety, such as warehouses looking to switch to Hydrogen-powered forklifts, or fuel stations upgrading for customers who want to fill up their new emission-free cars with Hydrogen. R. STAHL supports Hydrogen end users with automation and lighting solutions as well as OEM packages for various applications.



PRODUCTION | DISTRIBUTION | UTILISATION

R. STAHL IN THE HYDROGEN VALUE CHAIN

Locations highlighted in yellow are hazardous areas that require special explosion protection equipment such as ours. R. STAHL has decades of experience in building solutions for any kind of Hydrogen-based industry or technology, protecting every H_2 molecule from the moment it's produced to the moment it's used.

1 Our technologies protect **Hydrogen electrolysers** from any ignition of the free H_2 that is being produced there.

2 **Steam reformers** have to be protected from several explosion hazards at the same time because they turn gas into Hydrogen.

3 When Hydrogen is used for **grid balancing**, the Hydrogen needs to be stored and then converted back to electricity, which creates hazardous areas at these points.

4 Any plant dedicated to the **conversion** of Hydrogen into H_2 fuel, LH_2, LOHC, ammonia, methanol or SAF/SNG needs specific explosion protection, often against multiple hazards.

5 We have been protecting Hydrogen-using **industries** such as the chemical and refining industries for many years, building up our experience at the forefront of real-world use – experience we can easily translate into solutions for new users of H_2, such as the steel, glass, pharmaceutical and cement sectors.

THE BEST PARTNER FOR YOUR H_2 FUTURE.

If you would like to know more about how to make your future with Hydrogen green, efficient and safe, just get in touch with us. Our experts are looking forward to sharing their knowledge with you, to show you what sets our technologies apart from the rest, and to give you the confidence to venture into a greener tomorrow today.

Why The Green Link?

- R. STAHL has decades of experience in explosion protection for Hydrogen-based industries, and a broad range of products and services to show for it.
- We can design and build any system you require from scratch to meet your precise requirements without compromising on safety – and we can revise any existing safety architecture in the same way.
- Our products, systems and technologies are internationally certified and available for any region of the world, with local support and service always within reach from one of our many offices around the globe.

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