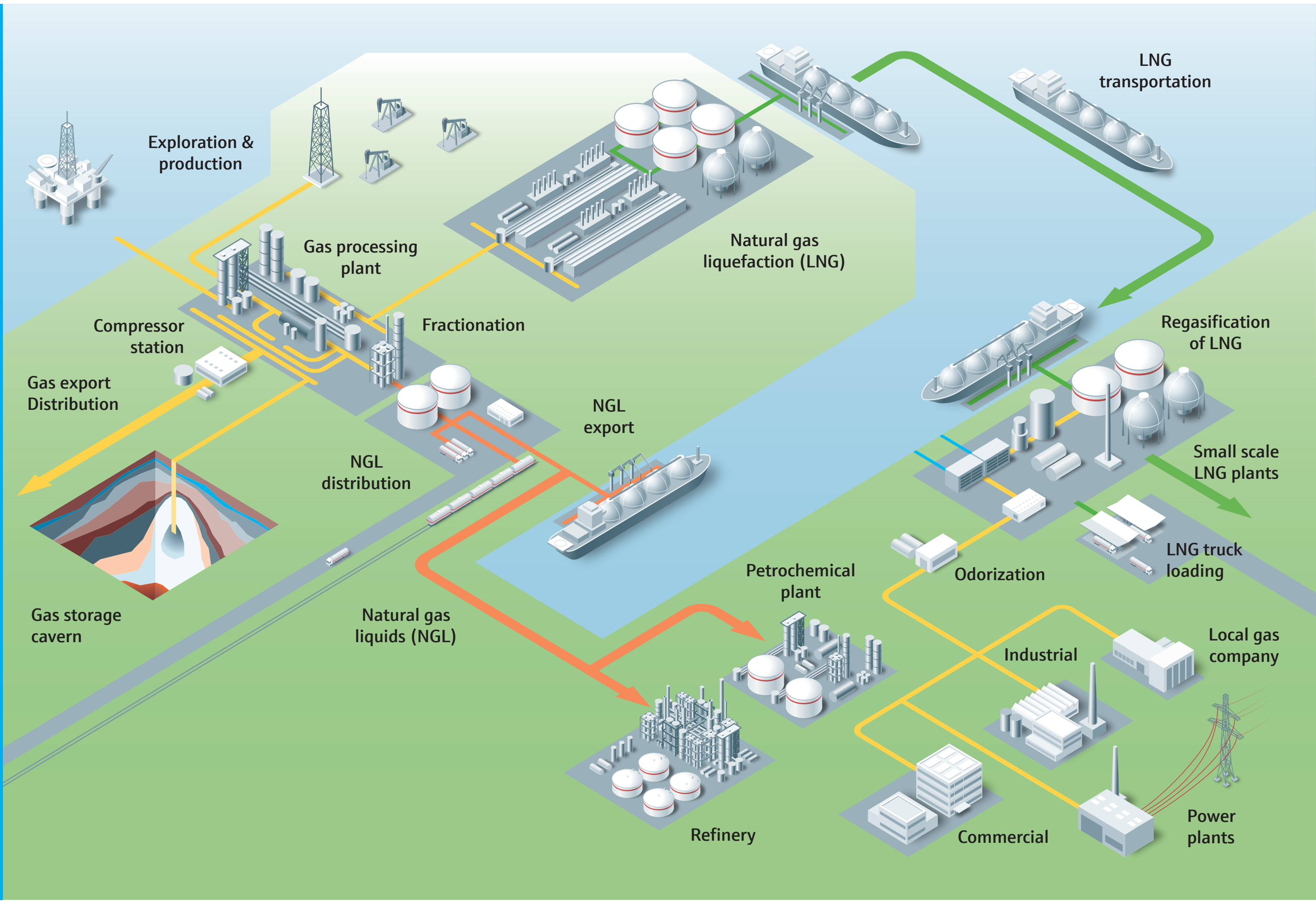
# Energy transition

## Our gas analyzers are ready

It is well understood across all continents that an energy transition is occurring where natural gas, biogas, liquid natural gas, and hydrogen play an increasing role as we aim to reach net-zero carbon dioxide goals set by policy makers globally. Use of natural gas in the global hydrocarbon energy mix is expected to grow from 26% to 30% by 2030, replacing more coal and petroleum liquids, according to the US Energy Information Administration. Liquid natural gas distribution and biogas production has also been expanding systematically.

A mix of hydrogen and natural gas, and pure hydrogen in some cases, is already occurring within regional and local energy supply chains. As energy sources and gas mixtures shift, the infrastructure to store and transport gas remains critically important. A changing mix of molecules and pipeline infrastructure, coupled with advancement in process automation, will further drive the need for on-line gas analysis for safety, process control, and gas quality in the future.




Endress+Hauser
People for Process Automation

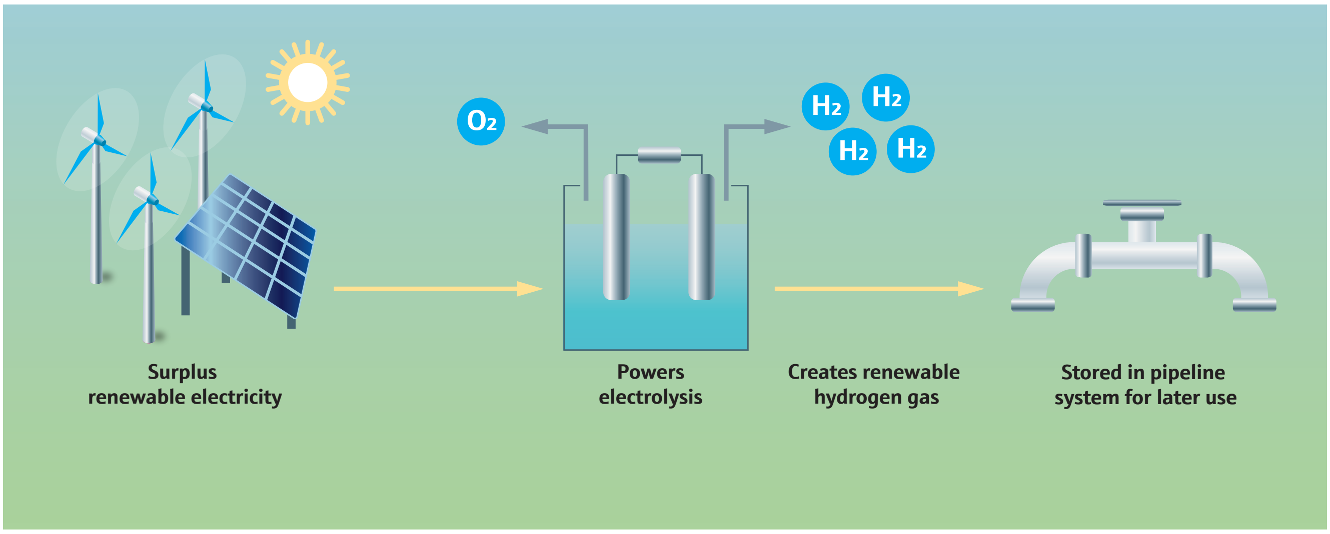
# Changes in the energy supply chain

## Hydrogen

Energy companies producing, treating, transporting, and distributing natural gas are now working towards a future with hydrogen as a significant component in the energy mix. For example, up to 30% hydrogen may be blended with natural gas and transported together. Power turbines are now being fueled with mixtures containing 50-70% hydrogen. 100% hydrogen-powered turbines are in development.

Hydrogen can be produced by electrolysis plants powered by solar or wind farms, and it becomes a way to store significant amounts of renewable energy. In addition, Hydrogen is delivered to the market via existing natural gas pipeline infrastructure by blending it with natural gas. This ability to store renewable energy and transport it within existing energy infrastructure makes solar and wind power less dependent on weather, and it enables peak shaving strategies commonly employed for traditional hydrocarbon sources.

Hydrogen is also produced by reforming methane, where carbon capture strategies are employed during production. In the decades ahead, energy transition could be further propelled by ongoing development and adoption of fuel cell technology, the use of pure hydrogen as a fuel source, and the use of pure hydrogen combined with captured $CO_2$ to form renewable natural gas.




## Natural gas, biogas, and LNG

The benefit of natural gas over coal and petroleum is reduced $CO_2$ emissions; it is the cleanest and greenest fossil fuel choice. For example, fossil $CO_2$ emissions in the US and Europe have been significantly reduced over the past two decades in large part by transition of coal to natural gas. Natural gas is forecasted to grow more rapidly than other energy sources through the next several decades as solar, wind, and new energy sources are developed and come to fruition. Biogas produced from animal waste, landfills, and wastewater significantly curb the greenhouse effect by capturing biogas and using it as fuel to reduce emissions. BioLNG has also started to surface in some geographies through small-scale modular LNG liquefaction trains, facilitating storage and transport of the fuel. Global LNG production and distribution has rapidly evolved from mega-LNG onshore plants with LNG transported via large carriers across oceans, to a more agile infrastructure. Floating LNG (FLNG) vessels for recovery of smaller gas-rich oil fields as well as smaller scale liquefaction trains for peak shaving, bunkering, and truck loading of LNG fuel are developing quickly across the globe. These investments are enabling power plants to switch from coal and for marine, land transportation, mining and construction equipment to switch from diesel to compressed natural gas fuel.

For decades, the natural gas industry has removed $CO_2$ from produced natural gas and treated it as a commodity for enhanced oil recovery (EOR) purposes. Now, more than ever, $CO_2$ is captured and sequestered underground as a greenhouse gas reduction strategy.

# Our TDLAS, QF, and Raman analyzers

## The role of gas analysis

A significant increase in the transport of hydrogen in pipelines seems straightforward on the surface, as the pipeline industry transports a variety of gases and the mix has changed over time. After all, hydrogen is another gaseous material like methane, carbon dioxide, and air, all of which are commonly transported today. However, hydrogen cannot replace methane overnight, as it will take decades for downstream consumers to switch to new fuel sources. In the coming years, natural gas will be blended with hydrogen at increasing concentrations.

As gas companies begin to integrate hydrogen gas, they must consider the impact on equipment. For example, hydrogen—being the lightest element on the periodic table—will influence the performance of pipeline pumps, valves, seals, and measurement equipment. Additionally, hydrogen atoms can be absorbed by some metals, causing them to lose ductility, resulting in "hydrogen embrittlement" and stress cracking.

Fortunately, for gas companies adapting fleets (small or large) of installed Endress+Hauser TDLAS, QF, and Raman analyzers, this process will be straightforward without impact on measurement reliability.

J22 and JT33 TDLAS gas analyzers

OXY5500 optical oxygen analyzer

Raman Rxn4 analyzer

Raman Rxn5 analyzer

## Ready to help you navigate the evolving energy transition

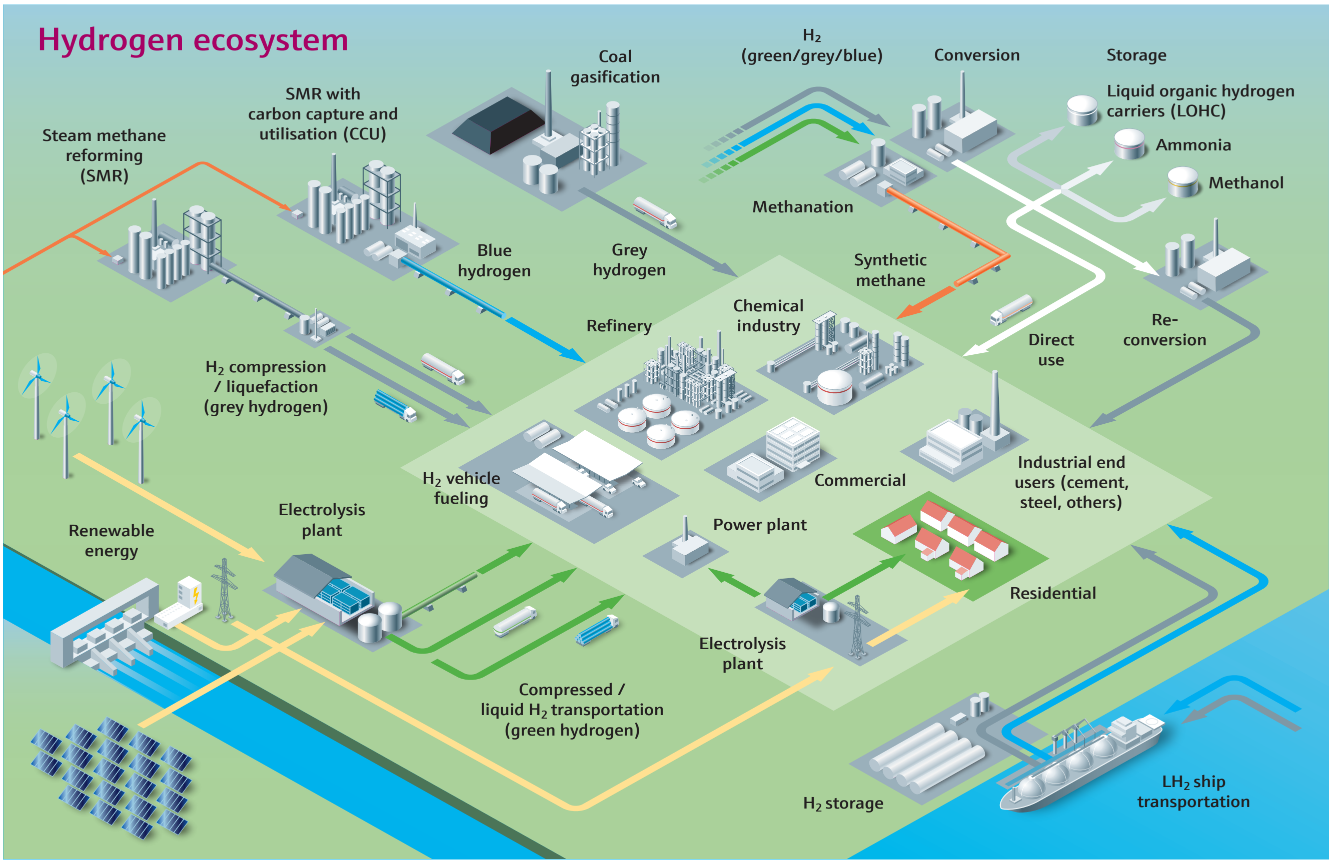
Endress+Hauser's gas analysis product portfolio reflects our expertise in working with hydrogen streams. Our analyzers incorporate the powerful measurement technologies of tunable diode laser absorption spectroscopy (TDLAS), quenched fluorescence (QF), and Raman spectroscopy. These offerings feature unique designs based upon decades of experience in natural gas, biogas, liquefied natural gas (LNG), and hydrogen. As such, Endress+Hauser analyzers are exceptionally future proof and well adapted to help companies navigate the energy transition ahead.

In refineries, hydrogen is used in catalytic reforming to convert naphthas into high-octane liquid products. Catalytical reforming processes utilize Endress+Hauser TDLAS analyzers in hydrogen streams where moisture, $H_2S$, and composition must be measured and controlled. Through early involvement in these process control applications, we developed instruments, probes, and sample handling systems for hydrogen that are unaffected by stress cracking. We invested early in hydrogen blending stations to simulate customer streams for research and development, production calibration, and testing in hydrogen.

Endress+Hauser Raman analyzers have also been successfully deployed to measure composition in hydrogen streams. In these cases, Raman analyzers are typically used for catalytic reforming and for fuel feed calorific value, Wobbe index, and compositional analysis in hydrogen-rich natural gas mixtures for power plant turbines.

Pipeline companies with existing fleets of TDLAS, QF, and Raman analyzers from Endress+Hauser can be assured that the introduction of hydrogen into natural gas streams will not require modifications or upgrades. The mechanical, electrical, and optical systems of Endress+Hauser gas analyzers are completely unaffected because the systems are designed for both hydrogen and hydrocarbon service.

New TDLAS products introduced by Endress+Hauser, such as the J22 for H2O measurement and JT33 for H2S measurements, have built-in capability for hydrogen-containing natural gas streams. Adjusting the instrument is a simple field adjustment to the $H_2$ concentration found in the user menu.




## Safety considerations

The requirements for electrical equipment in hazardous areas with hydrogen is stricter than for natural gas. The gas group for hazardous area certifications is Group IIB+$H_2$ or greater in the NEC & IEC Zone System or Group B in the NEC Division System. Endress+Hauser analyzers carry these necessary approvals for hydrogen service. Additionally, the gas handling systems, as mentioned above, are designed with pure hydrogen in mind. Overall, Endress+Hauser analyzers, whether installed in the field today or destined for the field tomorrow, are designed for and carry the necessary approvals for hydrogen service.

## Conclusion

Endress+Hauser is effectively positioned to serve the gas analysis needs of the ongoing energy transition. We have expertise in applications where hydrogen is present in the oil & gas industry, and extensive experience in natural gas quality measurements for production, storage, transportation, and distribution. Our products are designed for hydrogen service and have the applicable hazardous area approvals. We serve a large global installed base that rely on Endress+Hauser gas analyzers to measure moisture, $H_2S$, oxygen, calorific value, full composition, and other contaminants in hydrogen blends. Endress+Hauser has the R&D, production experience, and the manufacturing equipment required for test and calibration in hydrogen blends.

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