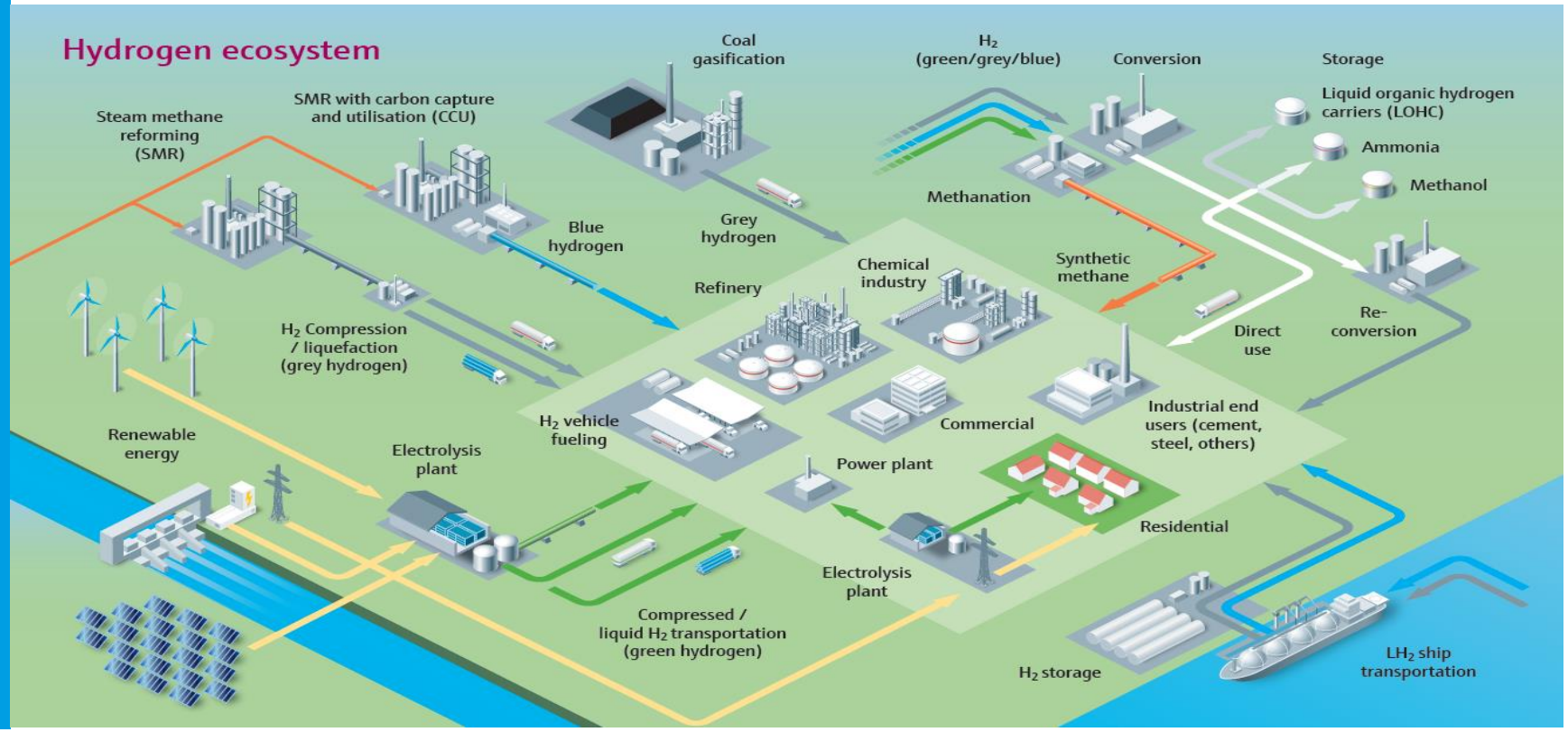
# DSO - Knowledge Exchange Green Hydrogen production and utilization

Norbert Meszaros, Team Leader | Business Driver
Jens Hundrieser, Regional Industry Manager Europe Energy+Gas






Endress+Hauser
People for Process Automation

# Your speaker


## Norbert Meszaros

Elektroingenieur

International Management Studies

**Team Leader Business Driver, Energy Transition Expert**

norbert.meszaros@endress.com


- Since 16 years in Gas Measurement and Analysis
- Member of div. Associations
- Member of European and Global Energy Transition Network of Endress+Hauser
- Member of DACH Power & Energy Network of Endress+Hauser

Endress+Hauser GmbH - Lehnergasse 4, 1230 Wien, Austria

# Your speaker

## Jens Hundrieser

Dipl. Ing. Elektrotechnik

**European Industry Manager**
jens.hundrieser@endress.com

Jens Hundrieser
Scan and save my contact data

- worked in product and industry management in a wide variety of process industries at Endress+Hauser for almost 34 years
- Member of the Endress+Hauser core team for the global energy transition with hydrogen as a key element with a clear focus on implementing sustainable goals for decarbonization and defossilization
- Member for Endress+Hauser at the European Clean Hydrogen Alliance

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79576 Weil am Rhein

# Agenda

- Short portfolio overview Endress+Hauser
- Decarbonization of industrial sectors
- Green production overview, references and our offering
- Power-to-Gas –Green $H_2$ production and utilization– APPLICATOR
- Hydrogen processing - optical Analysis solution for purity and quality 5.0
- Gas turbine with hydrogen blending as example for $H_2$ usage
- Summary - Endress+Hauser´s
  - Portfolio in Hydrogen projects
  - Commitment to Net zero emissions

# Facts & Figures 2023

# Single source supplier: broadest portfolio in process automation

Heartbeat Technology

| Level | Flow | Analysis | Pressure | Temperature | Data Aqui. | Systems | Services |
|---|---|---|---|---|---|---|---|
| Capacitance | Electromagn. | pH - Value | Pressure gauge | RTD | Data Managers | Profibus PA | Commissioning |
| Conductive | Vortex | Conductivity | Pressure abs. | Thermocouple | Energy Managers | Fieldbus FF | Maintenance |
| Hydrostatic | Coriolis | Oxygen | Diff. - Pressure | Transmitter | Displays | Wireless HART | Repair |
| Differential | Ultrasonic | Turbidity | Hydro. - Press | Multi-point | Data logger | Operations App | Calibration |
| Vibration | T-mass | Silicate | | Octopus | Barriers | SmartBlue | Training |
| Ultrasonic | Venturi | Chlorine | | Skin Point | Contactors | Process Trans. | Spare parts |
| Radar | Orifice | Ammonium | | | Power Supplies | Systems | Equipment Hire |
| Guided Wave | DP-flow | Phosphate | | | | | Inst. Base Mgmt. |
| Electromech. | | Nitrate | | | | | Engineering |
| Radiometric | | Sludge level | | | | | |
| Servo | | Water sampler | | | | | |
| | | TDLAS | | | | | |
| | | Raman | | | | | |





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# What Heartbeat Technology can do for you

## Increase your plant availability and ...

... boost reliability as well as safety levels

... reduce your verification efforts

... improve your process performance

## Heartbeat Technology

### for diagnostics

Permanent process and device diagnostics

### for verification


Documented device functionality without process interruption

### for monitoring


Information for process optimization and predictive maintenance

# Decarbonization of industrial sectors

McKinsey&Company

Decarbonization of industrial sectors: the next frontier

June 2018

## Decarbonization options

Decarbonization options for the four focus sectors can be grouped into the following categories: (Exhibit 6)

- **Demand-side measures.** Decreasing the demand for an industrial product should lead to lower production and $CO_2$ emissions. For example, light-weighting can reduce the demand for steel, and cement could be replaced by materials such as wood. In addition, increasing the circularity of products, e.g., by increasing recycling or reuse of plastics and steel, would lessen $CO_2$ emissions by reducing the production of virgin materials.

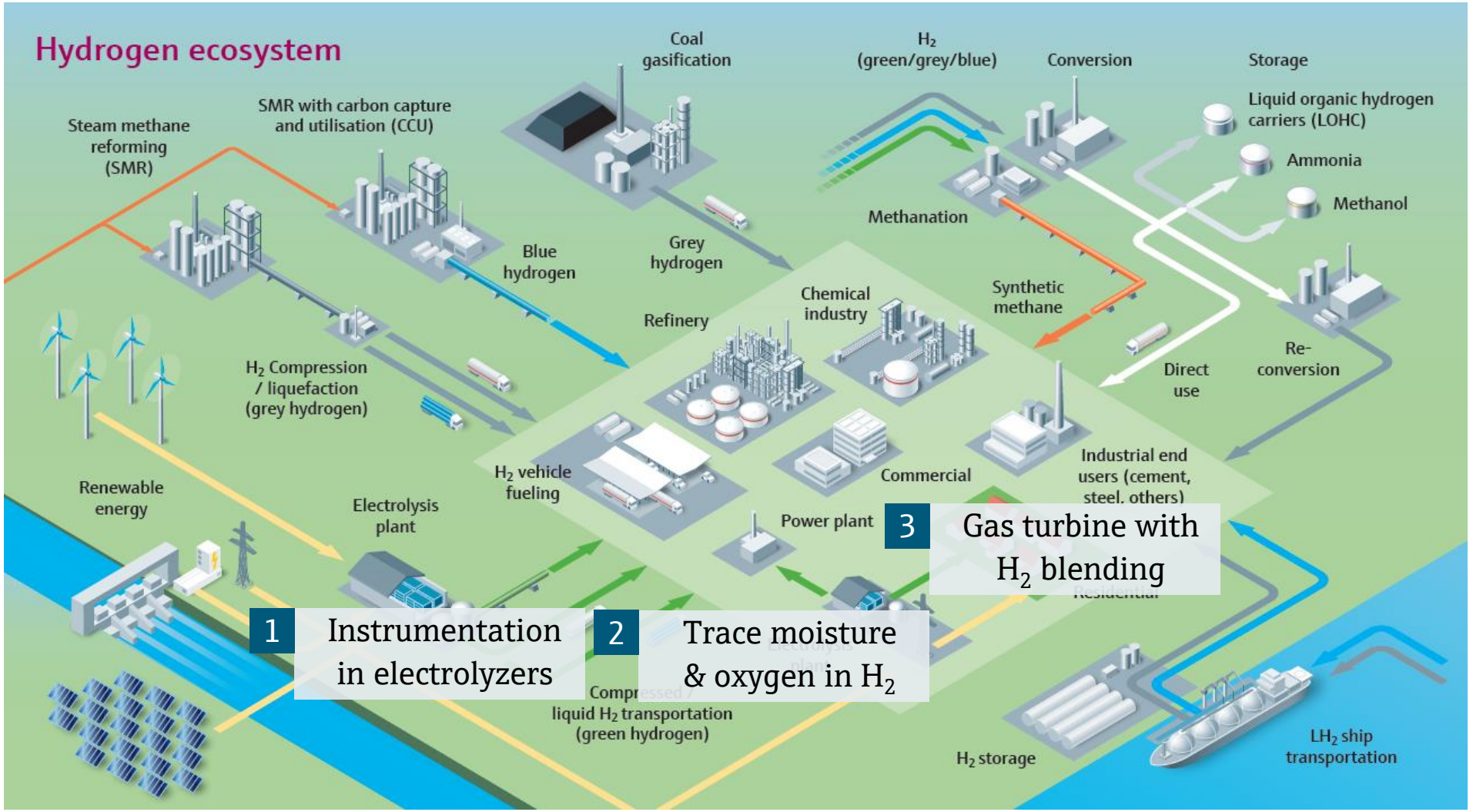
- **Energy-efficiency improvements.** Increases in energy efficiency can economically cut fuel consumption for energy use by 15 to 20 percent across sectors.[17] Potential gains in energy efficiency will differ between sectors and facilities. Generally speaking, developed regions will tend to be closer to the low end of that range, and developing regions closer to the high end. Using less fossil energy to make industrial products will lower $CO_2$ emissions.

- **Electrification of heat.** Emissions from the use of fossil fuels to generate heat can be abated by switching to furnaces, boilers, and heat pumps that run on zero-carbon electricity. Electrifying heat can involve a change in the production processes. For example, to electrify ethylene production, companies need to install both electric furnaces and electrically driven compressors.

- **Hydrogen usage.** Emissions from the consumption of fossil fuel for heat and emissions from certain feedstocks can be abated by changing them for zero-carbon hydrogen. In this report it is assumed that hydrogen is generated by using zero-carbon electricity for the electrolysis of water. For example, ammonia production can be decarbonized by replacing the natural gas feedstock with zero-carbon hydrogen.

*Source :* McKinsey 2018

# Hydrogen production and utilization in various sectors



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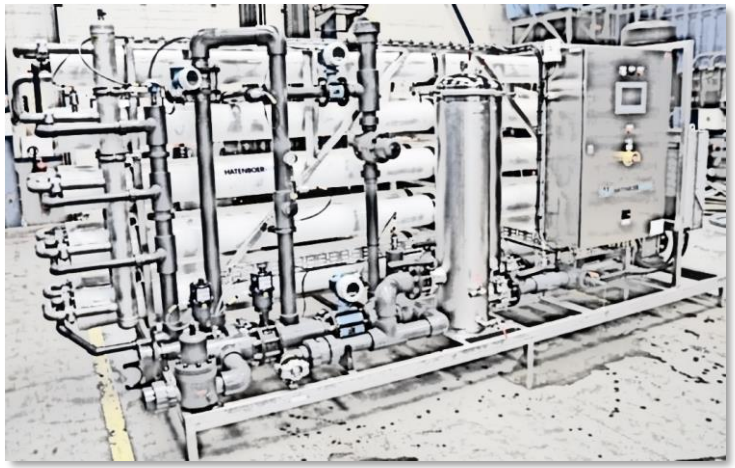
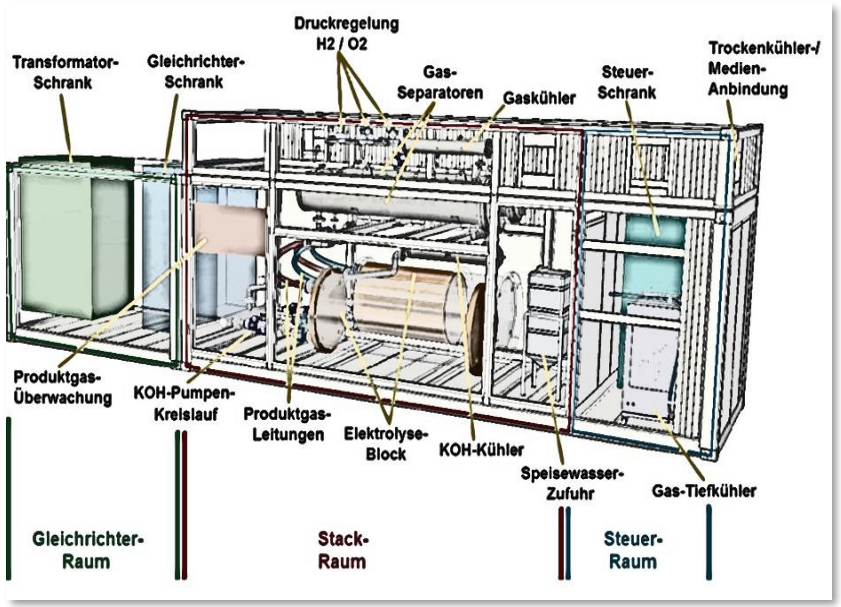
# 1. Green hydrogen production from electrolyser – e.g. Alkali



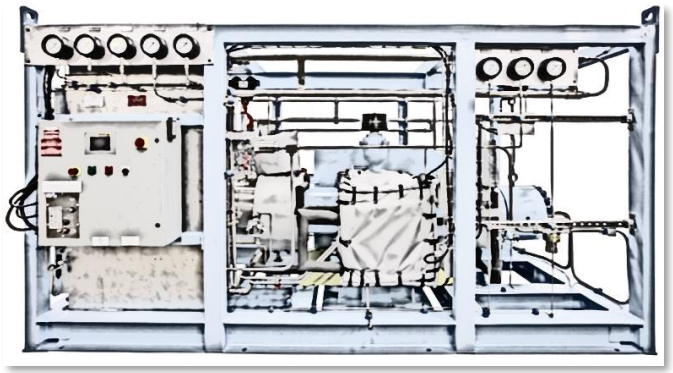
**Water purification / demineralization**




**Electrolysis**

## Green Hydrogen

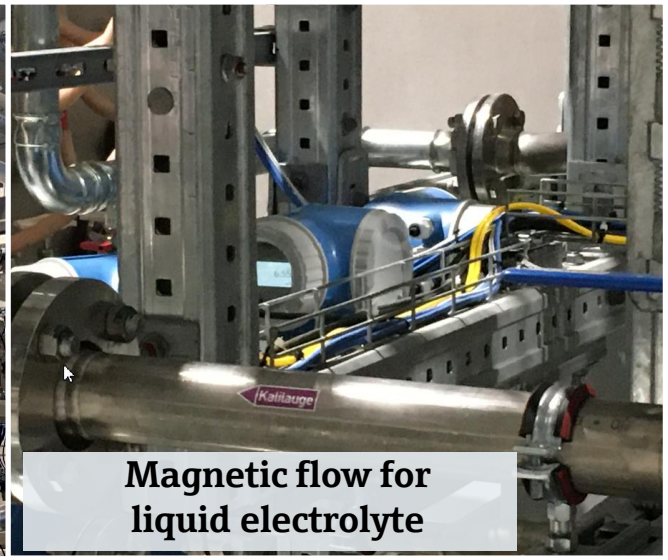
Green $H_2$ refers to hydrogen produced by the electrolysis of water, with the electricity used in the process coming from renewable sources such as sun, water and wind



**Hydrogen compression**

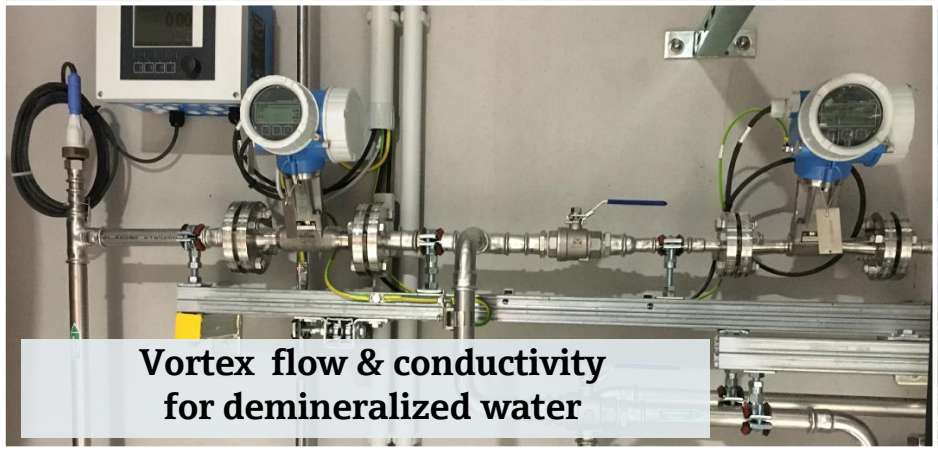
# 1. Reference installation in alkaline electrolyser – “Whylen – Germany”

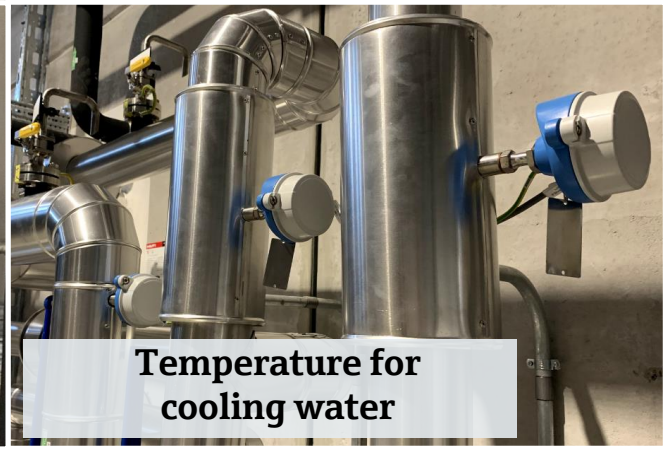

Electrolyser Plant
–in operation since 2019



Magnetic flow for
liquid electrolyte


Pressure for
hydrogen cyclinder


Vortex flow & conductivity
for demineralized water

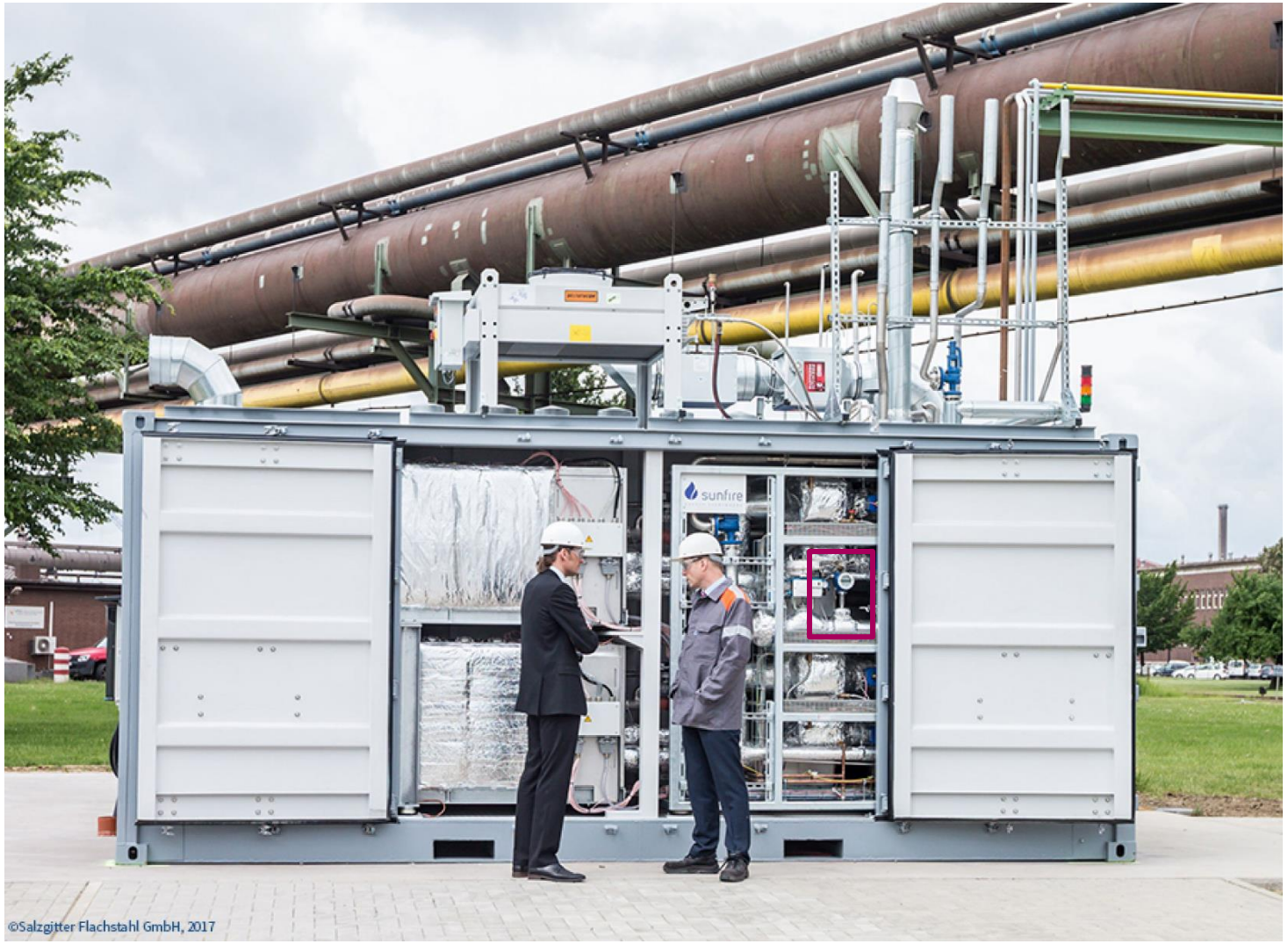

Temperature for
cooling water

# 1. Reference installation in another alkaline electrolyser


# 1. Reference installation in PEM electrolyzer

https://changes.endress.com/en/hitting-gas-hydrogen

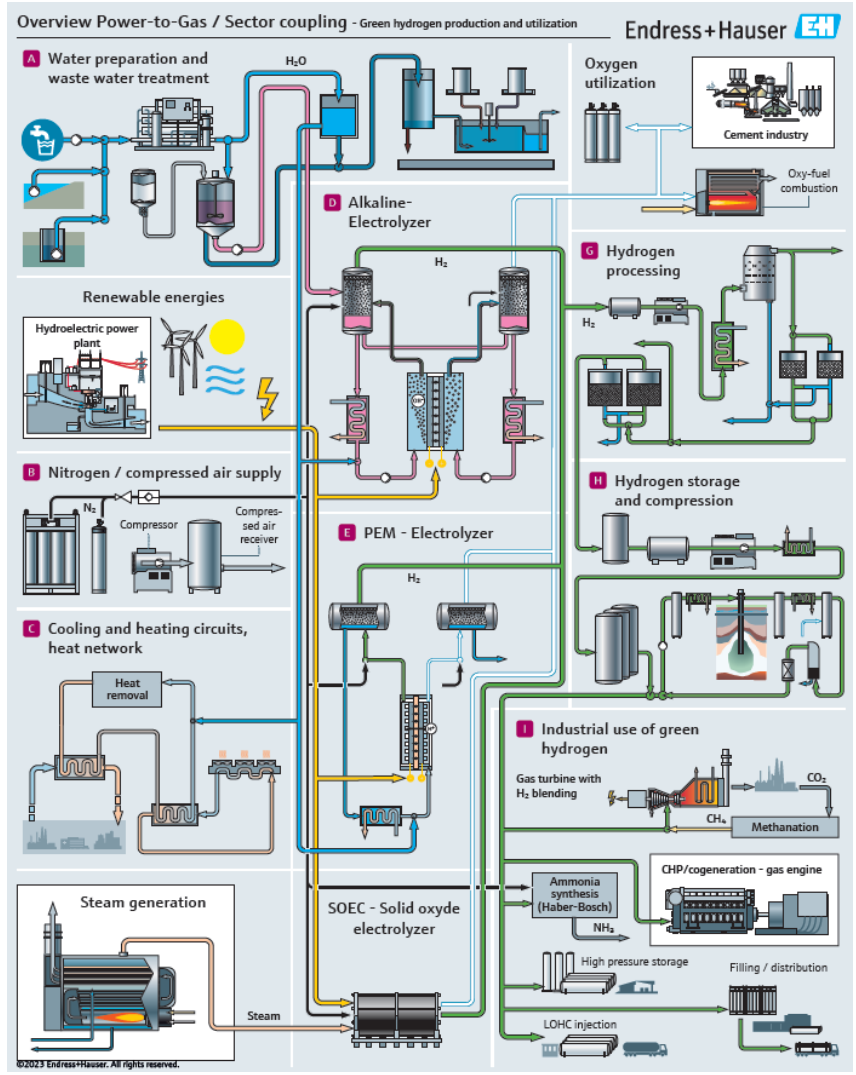
# 1. Reference installation in SOEC electrolyzer

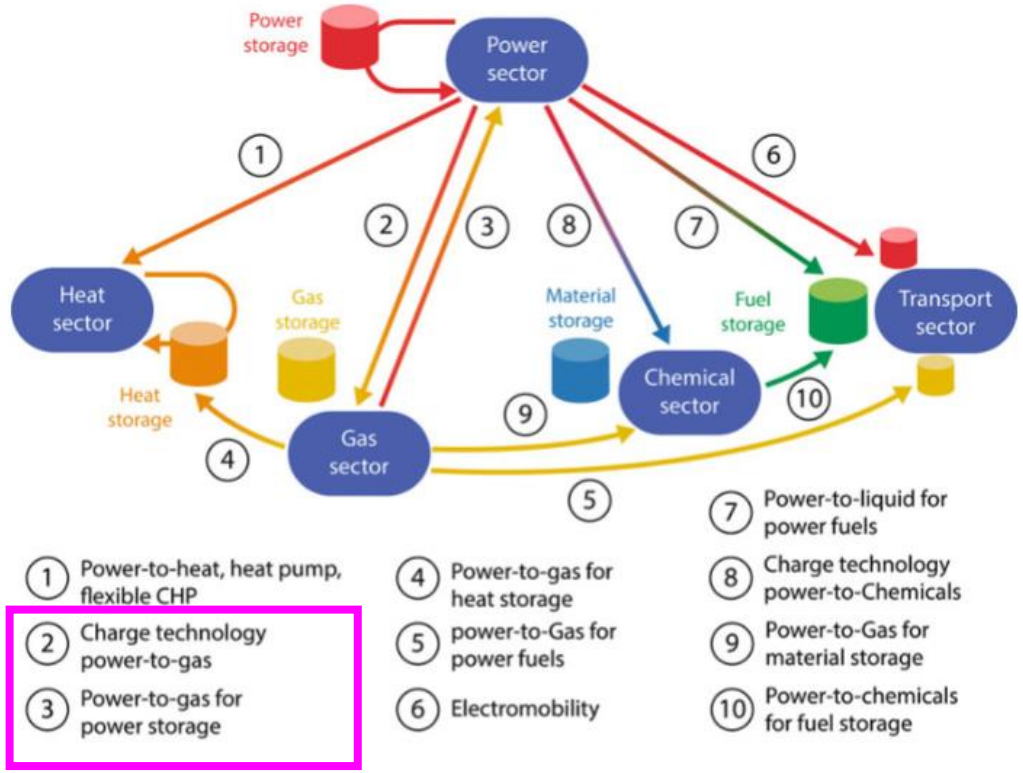



**with thermal mass flow meter t-mass 150 measurement**

**and Coriolis mass flow meter in DN04 for small quantities of steam in kg/h (overheated)**

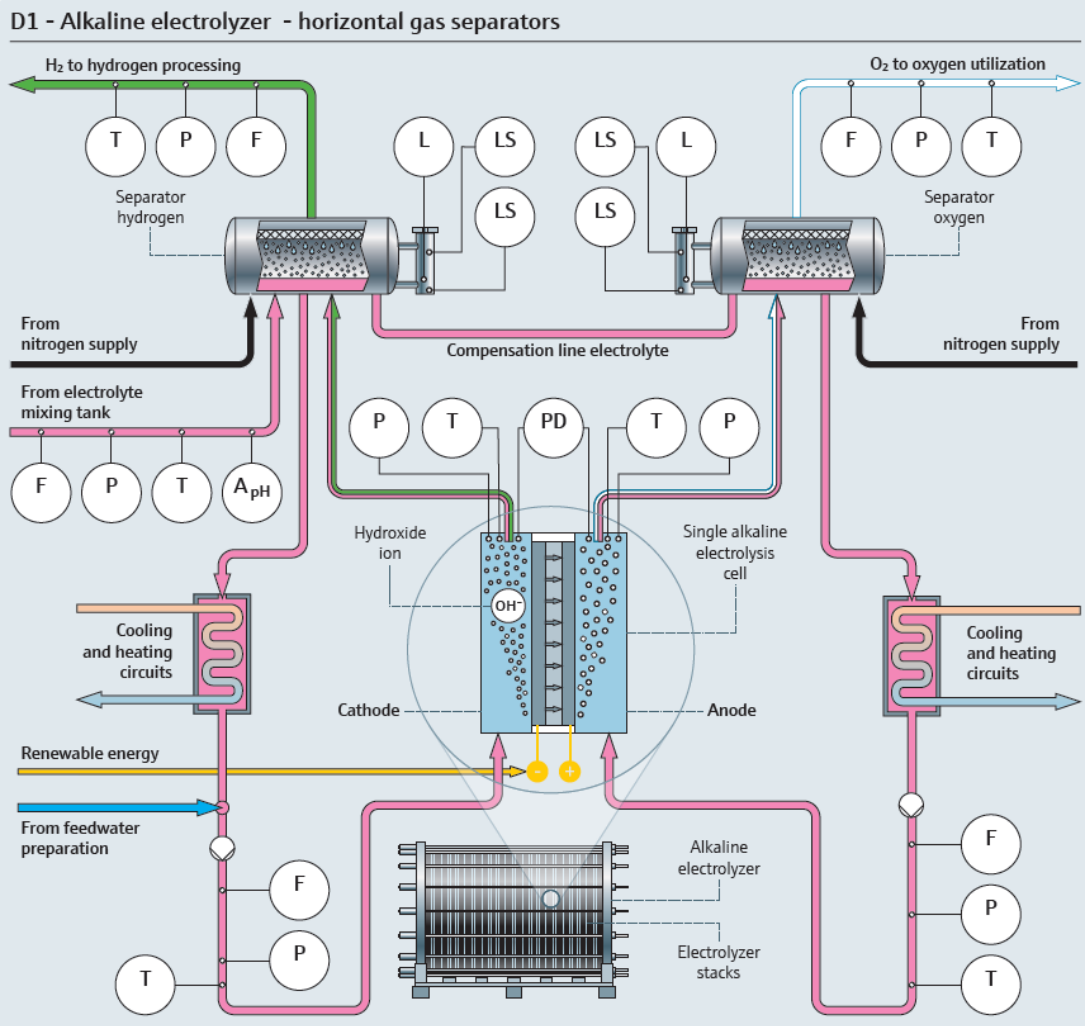
# 1. Power-to-Gas –Green $H_2$ production and utilization– APPLICATOR (in prep.)

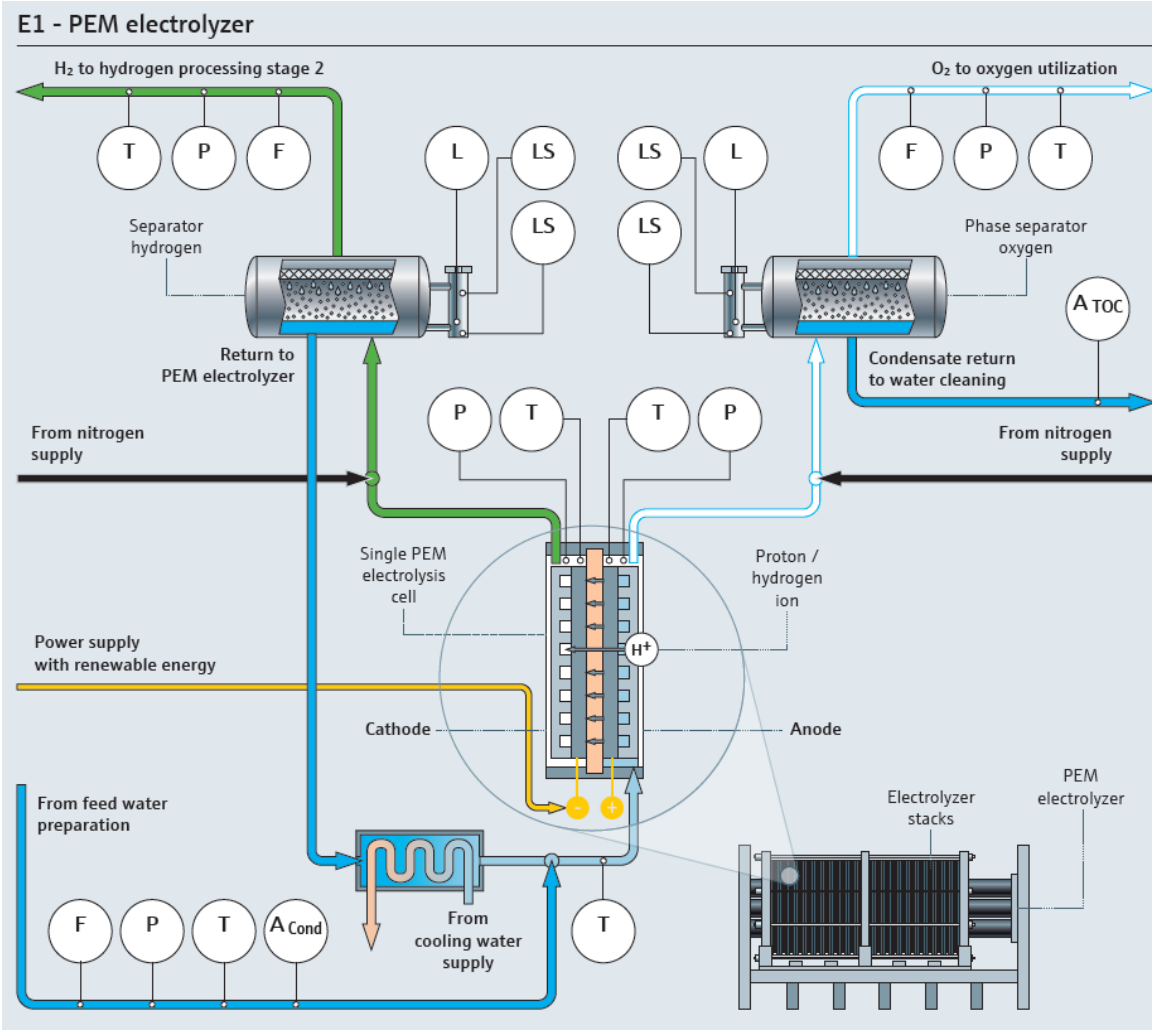



Source: [Michael Sterner · Ingo Stadler Handbook of Energy Storage]

# 1. Alkaline & PEM Electrolyzers: Instrumentation



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# 1. Product portfolio for green hydrogen production

## Flow (electrolyte + hydrogen)


## Pressure and Temperature

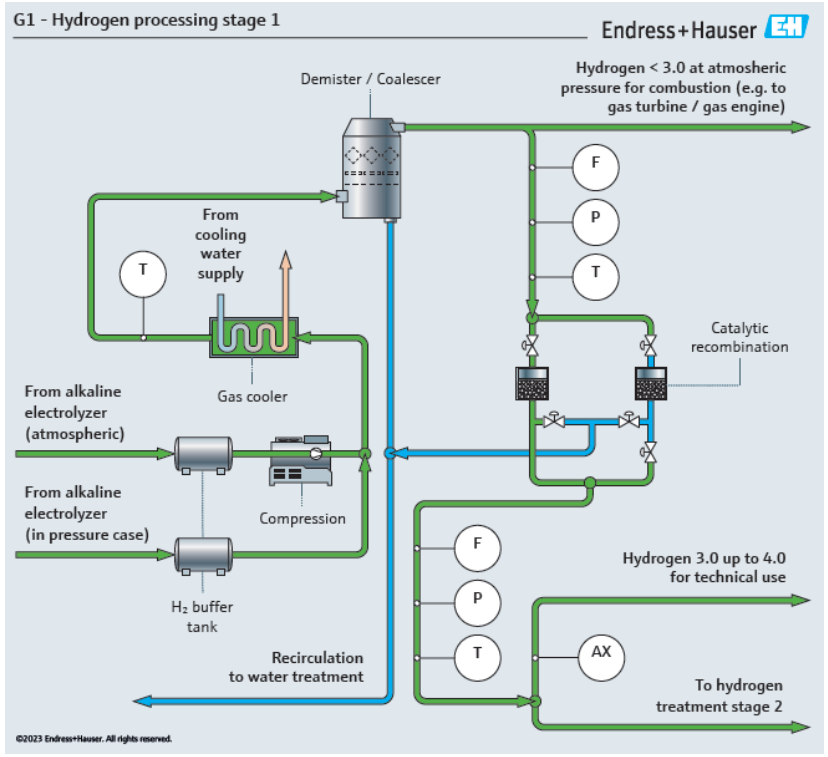

## Limit detection and level

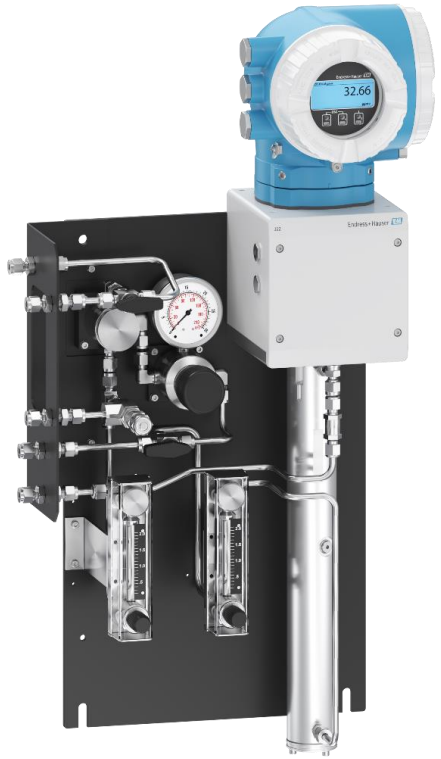

## Liquid analysis: conductivity ..


## Gas analysis and composition

# 2. Hydrogen processing - optical Analysis solution for purity and quality 5.0

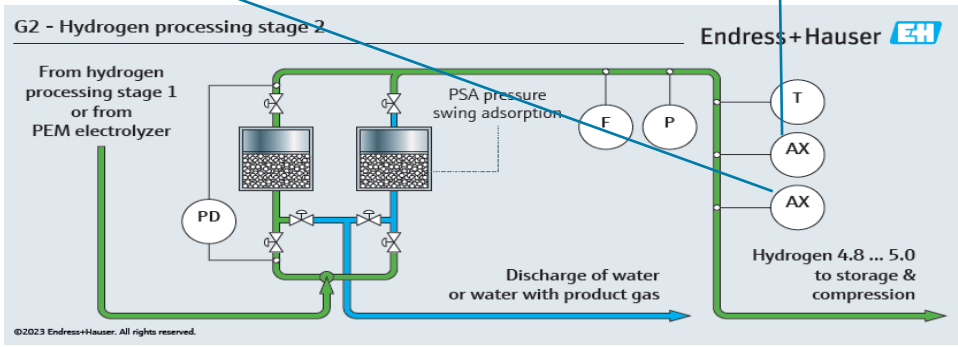
- Gas Analysis of trace oxygen and moisture in a gas stream, e.g. Hydrogen
- 2 analysis techniques: TDLAS + fluorescence spectroscopy
- 1 common system for gas sample preparation
- Critical $H_2$ supply chain impurities identified in ISO 19880-8 (from ISO-14687)



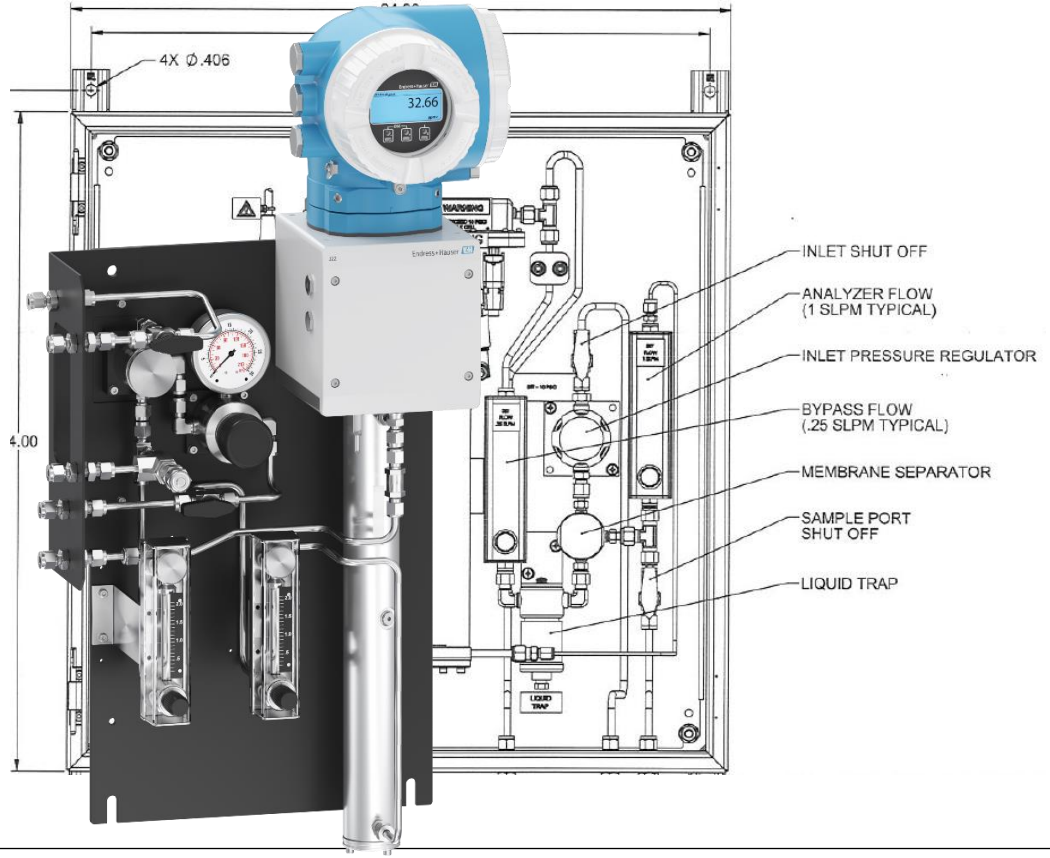
0-5ppm
$O_2$ in $H_2$

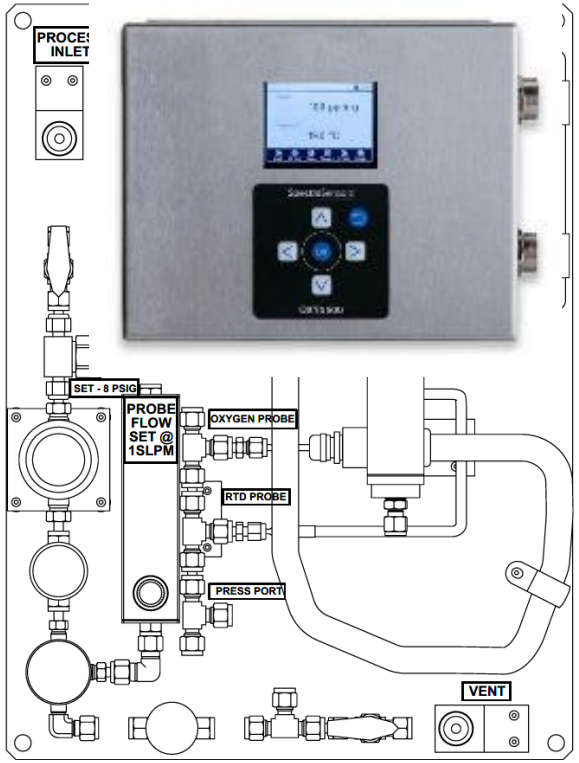
0-5ppm
$H_2O$ in $H_2$



# 2. Multi-component solution (Option)

- Gas Analysis of trace oxygen and moisture in a gas stream, e.g. Hydrogen
- 2 analysis techniques: TDLAS + fluorescence spectroscopy
- 1 common system for gas sample preparation



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# 2. Optical Analysis solution for Hydrogen purity and quality

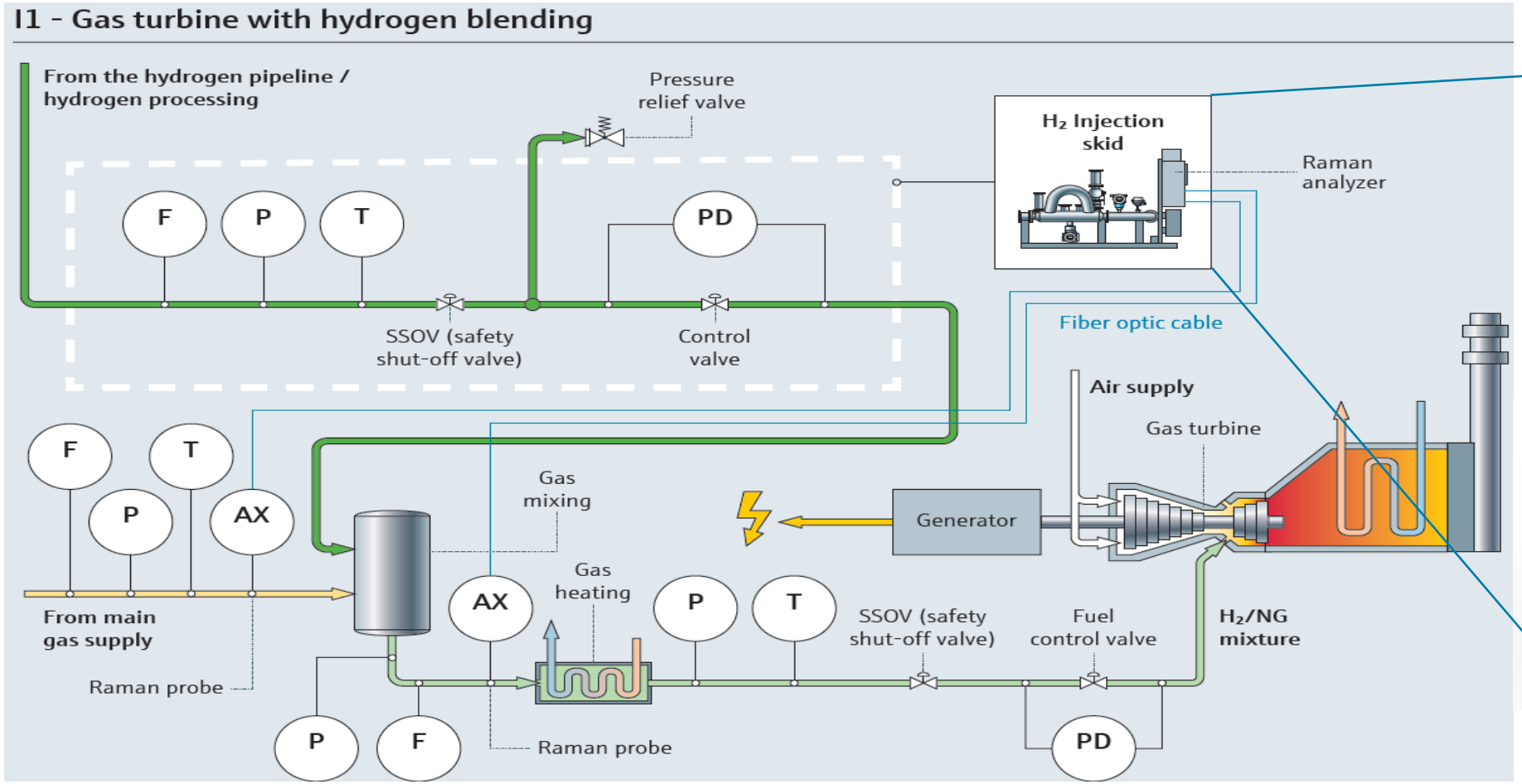
With this solution it's possible to measure and check the presence of impurities in Hydrogen

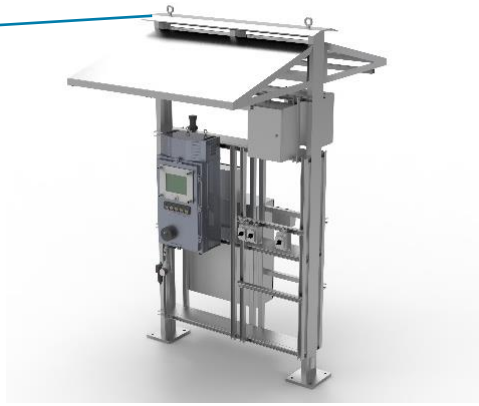
- Moisture $H_2O$ content range 0…10/200/500 ppm with TDLAS J22
- Oxygen content range 0…10 ppm with Quenched Fluorescence (QF) OXY5500

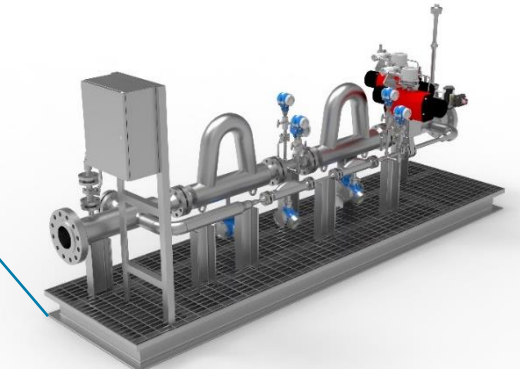
# 2. First reference to the multi-component solution plus other measuring devices

SCAN ME

# 3. Gas turbine with hydrogen blending as example for $H_2$ usage







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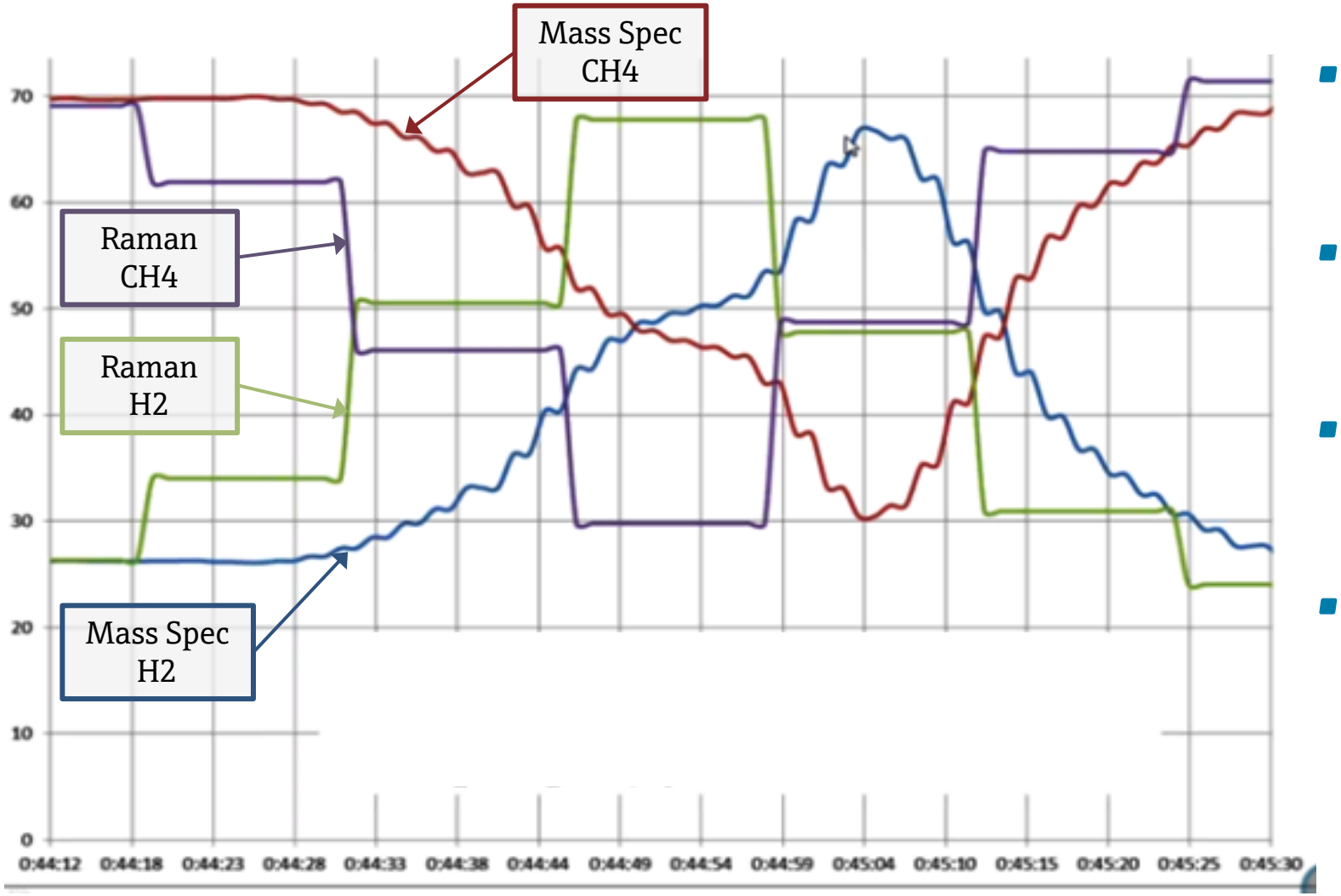
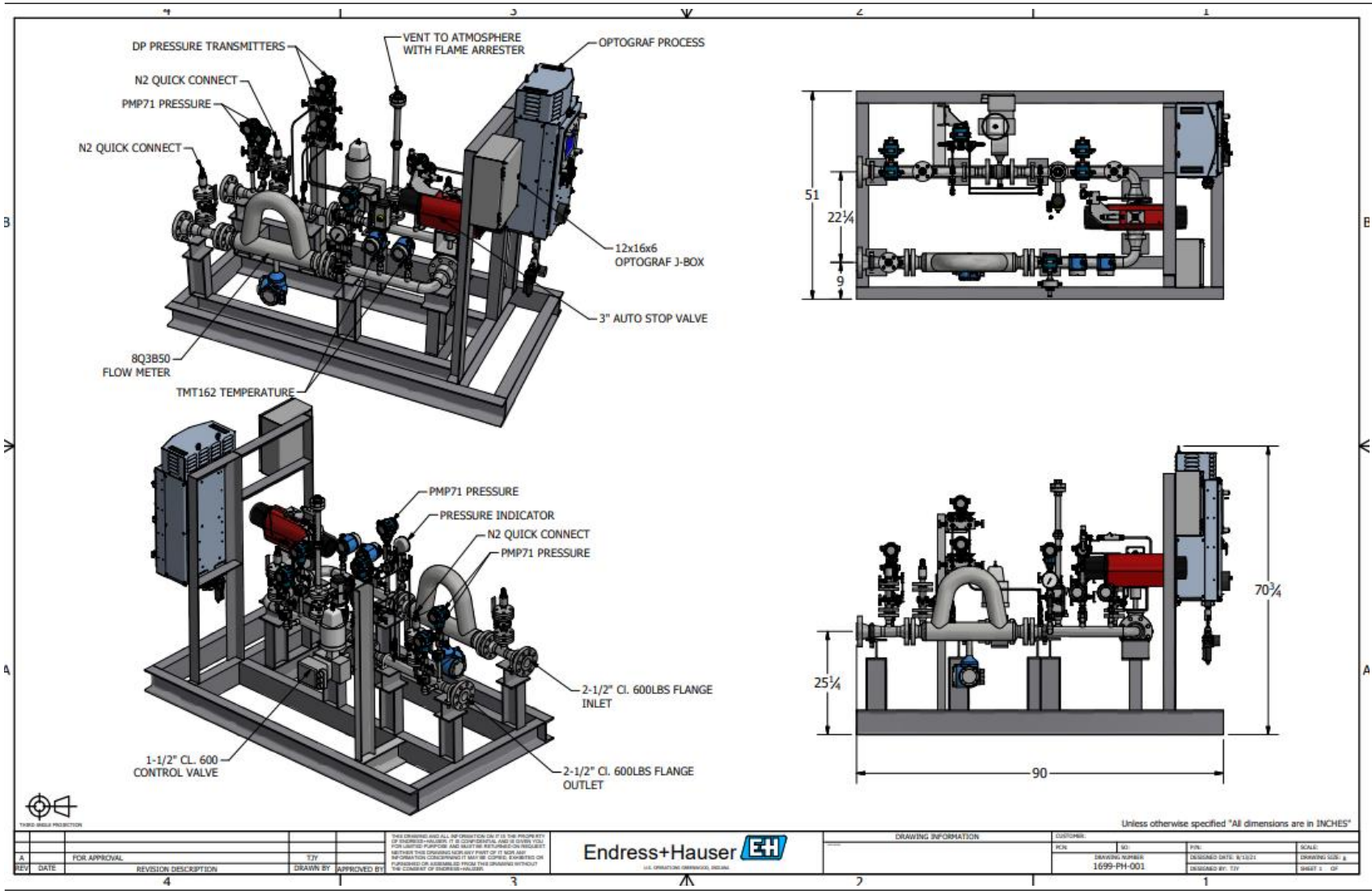
# 3. Raman: powerful gas composition analysis – admixture of $H_2$

# 3. Raman Transient Event Performance – Blending with Hydrogen




- Non-extractive (emission free) & continuous measurement
- Spike of **$H_2$ from 30% to 70% in 30 seconds** to simulate an extreme transient event
- Extreme transient event followed well by RXN5 (**15 sec** cycle time)
- Mass Spectrometer typical:
  - **Slow** cycle time
  - **Severe lag** due to sample conditioning

# 3. Hydrogen gas as fuel in gas turbines – skid solution




Products Solutions Services

## Hydrogen blending for natural gas-fired turbines

Long Ridge Energy showcases successful use of clean hydrogen power

LONG RIDGE ENERGY & POWER

Headquartered in Hannibal, Ohio in the Appalachia region of the U.S., Long Ridge Energy developed the first purpose-built, utility-scale hydrogen combined cycle power plant in the world. The 485-MW natural gas-powered facility is currently injecting hydrogen into the natural gas it burns, proving the viability of carbon-free renewable hydrogen for cleaner power generation.

"Here at Long Ridge, we had a first in the world achievement blending hydrogen in our fuel, working with Endress+Hauser in a partnership toward sustainable energy."

Mark Barry
Program Manager
Long Ridge Energy

The Long Ridge Energy power plant terminal in Hannibal, Ohio USA

**With the help of process measurement solutions from Endress+Hauser, a new Long Ridge Energy (LRE) power plant is successfully showcasing the viability of clean hydrogen in the global Power & Energy industry.**

**The results**

- A proven path toward decarbonization using clean burning hydrogen
- An efficient and safe hydrogen injection fuel system with blend validation using Raman spectroscopy
- EPA compliance (40 CFR Part 75) using reliable fuel flowmeters
- Innovative energy job creation to boost the local economy

**Setting the stage** As the world grapples with climate change and natural resource limitations, governments, companies, and communities are heavily investing in the evaluation of various renewable energy solutions.

While solar and wind often receive the most attention, these energy sources are limited by variations in peak generation capacity, and they struggle to meet widely fluctuating user demand.

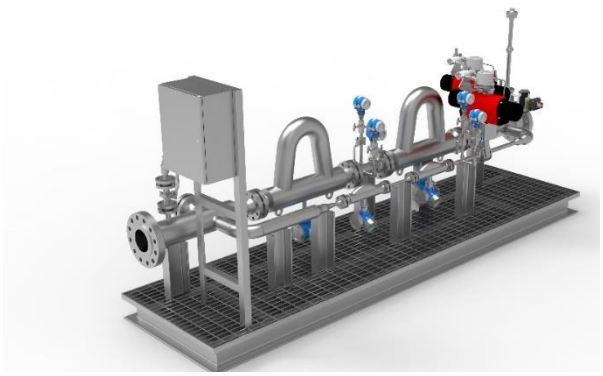
Renewable sources of hydrogen are growing in importance as an alternative means of storing energy because they can be converted to heat and electricity by fuel cells or gas turbines at any time.

The turbine at LRE's Hannibal, Ohio USA facility accept natural gas as a feedstock. Although better for the environment than coal, natural gas is a fossil fuel which makes it subject to scrutiny from regulatory bodies and local communities. Hydrogen burns cleaner, providing a path for partially decarbonizing the fuel source.

Endress+Hauser

[Hydrogen blending for natural gas-fired turbines | Endress+Hauser]

# 3. Without hydrogen, no energy transition



SCAN ME

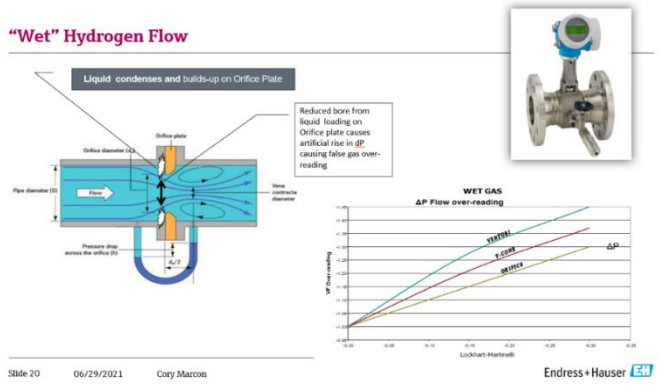
# Hydrogen: installed base and project examples

## $LH_2$ Level


## 0-5ppm $H_2O$ in $H_2$

## 0-5ppm $O_2$ in $H_2$

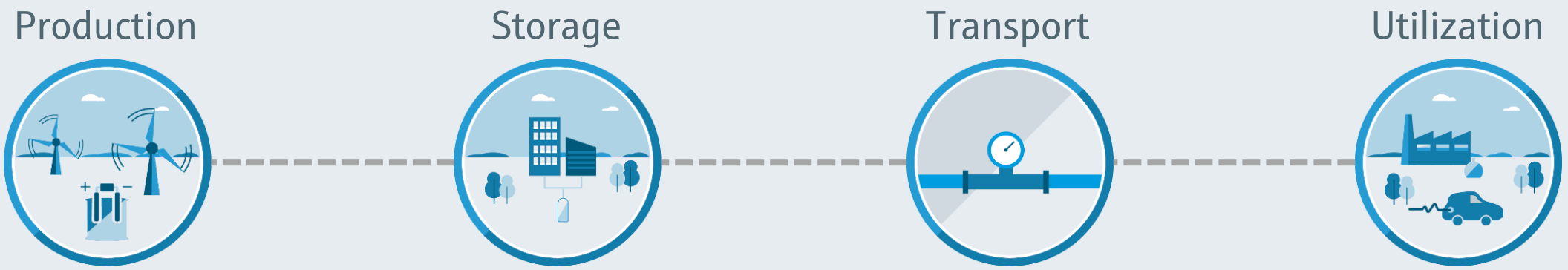
## Wet $H_2$ Flow




## PEM / Alkali-Instrumentation


## $H_2$% in NG CCGT power plant

# Our Offering across the Hydrogen Value Chain




## Quality measurement

## Quantity measurement

## Composition measurement



Endress+Hauser

# Our Contribution towards a Green and Sustainable Future


We are committed and support decarbonization and climate goal initiatives.

We are investing in people, products, solutions and services to support the development of hydrogen industry.

Our products are developed with highest standards of process and environmental safety.

Our product portfolio supports online measurement of quantity and quality parameters in the hydrogen production, storage, transportation and end use processes.