Hidrogén - Megoldásaink Magyarország számára

Megoldások a magyarországi hidrogénprojektekhez

Thomas Fuhrmann
Globális Hidrogén Kompetencia Központ
TUV Rheinland

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1872
Azért alapították, hogy biztosítsa a gyártóüzemek biztonságát

1904
Első járművizsgálat

1908
Első felvonóellenőrzés

1955
Első terméktanúsítás

2001
Az első internet-alapú tanúsítási adatbázis

2009
Globális piac piacvezető a fotovoltaikus tanúsításban

2012
Új tesztjelzés QR-kóddal a gyors kutatás és a nagyobb átláthatóság érdekében

2014
Az egyik legnagyobb független szolgáltató az ICT-biztonság területén

2017
Kiválósági Központ A dolgok vezeték nélküli internete (IoT)

Egy hosszú hagyomány mérföldkövei

TÜV Rheinland - számos TIC-szolgáltatás kezdeményezője

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We ensure quality & safety

5 BUSINESS STREAMS

24 BUSINESS FIELDS

INDUSTRIAL SERVICES & CYBERSECURITY

- Pressure Equipment
- Elevators & Lifting Equipment
- Electrical Engineering & Building Technology
- Industrial Inspection & Materials Testing
- Infrastructure & Project Supervision
- Energy & Environment
- Cybersecurity & Functional Safety

MOBILITY

- Periodical Technical Inspection
- Driver's License
- Car Services & Appraisal
- Engineering & Type Approval
- Rail

PRODUCTS

- Softlines
- Hardlines
- Electrical
- Solar & Commercial Products
- Medical

ACADEMY & LIFE CARE

- Occupational Health & Safety
- Training & HR Development
- Labour Market Services
- Digital Transformation

SYSTEMS

- Certification of Management Systems
- Customized Services
- Government Inspections & International Trade

Hydrogen news – hírfigyelő szolgálat

Highlights

29.06.2022	Germany/Australia: Australian-German business coalition releases roadmap for large-scale green hydrogen import to Germany
29.06.2022	Finland: Finnish National TSO for Gas Gasgrid Finland to Develop a National Hydrogen Infrastructure
29.06.2022	Tunisia: Launches Green Hydrogen Project H2Vert
29.06.2022	China: Is Aiming to Establish World Leadership in Hydrogen Technology
27.06.2022	Mauritania: EIB and Mauritania to scale green hydrogen investments

Competitors

23.06.2022	TÜV SÜD: New certification marks for fuel-cell systems and components of H2 systems
23.06.2022	DNV: Digital twin for hydrogen transport in GB's gas transmission system
22.06.2022	TÜV Rheinland partners with Conenergy

Investment / Funding

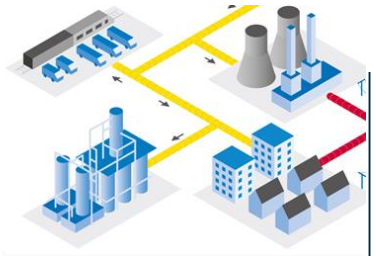
29.06.2022	Denmark/Norway: HydrogenPro AS – Funding Granted for Several New Projects for Green Hydrogen
29.06.2022	Norway: Norwegian hydrogen hub plans receive NOK 148m grant
29.06.2022	UK: £10million hydrogen innovation scheme for Scotland
29.06.2022	Denmark: DKK 88.8m grant for Power-to-X and green hydrogen development in Denmark

A TÜV Rheinland hidrogénnel kapcsolatos kompetenciaterületeinek áttekintése

A 6 alappillér







Power Erőművek	Production Gyártás	Storage Tárolás	Transport Szállítás	Distribution Elosztás	Application Végfelhasználás
▪ Wind power plants ▪ Solar/ photovoltaic systems ▪ Nuclear power ▪ Conventional power	▪ Electrolysis ▪ Natural gas steam reforming ▪ Methane pyrolysis (BASF)	▪ Geological / underground ▪ Industrial tank - LH2 - GH2 - LOHC - Ammonia - Methanol - SynFuels ▪ Carbon capture and storage / utilization	▪ High pressure pipeline / transport network ▪ Tank truck - LH2 - GH2 - LOHC ▪ Maritime vessels	▪ Natural gas distribution network ▪ Hydrogen network ▪ Refueling stations ▪ LOHC	▪ Heat ▪ Power ▪ Mobility ▪ Industry feedstock ▪ Ammonia production ▪ Steel production ▪ Methanol production

LH2 Folyékony hidrogén
GH2 Gáz-hidrogén
LOHC Folyékony szerves hidrogénhordozók

Főbb meglátások

- Az ágazatok összekapcsolása kulcsfontosságú
- Minden ágazatra és interfészre vonatkozó technológiai ismeretekre van szükség.
- A meglévő iparágakba beágyazandó új technológiák
- A meglévő (gáz)infrastruktúrák (szállítás és elosztás) és alkalmazások utólagos felszerelése/korszerűsítése lehetséges.

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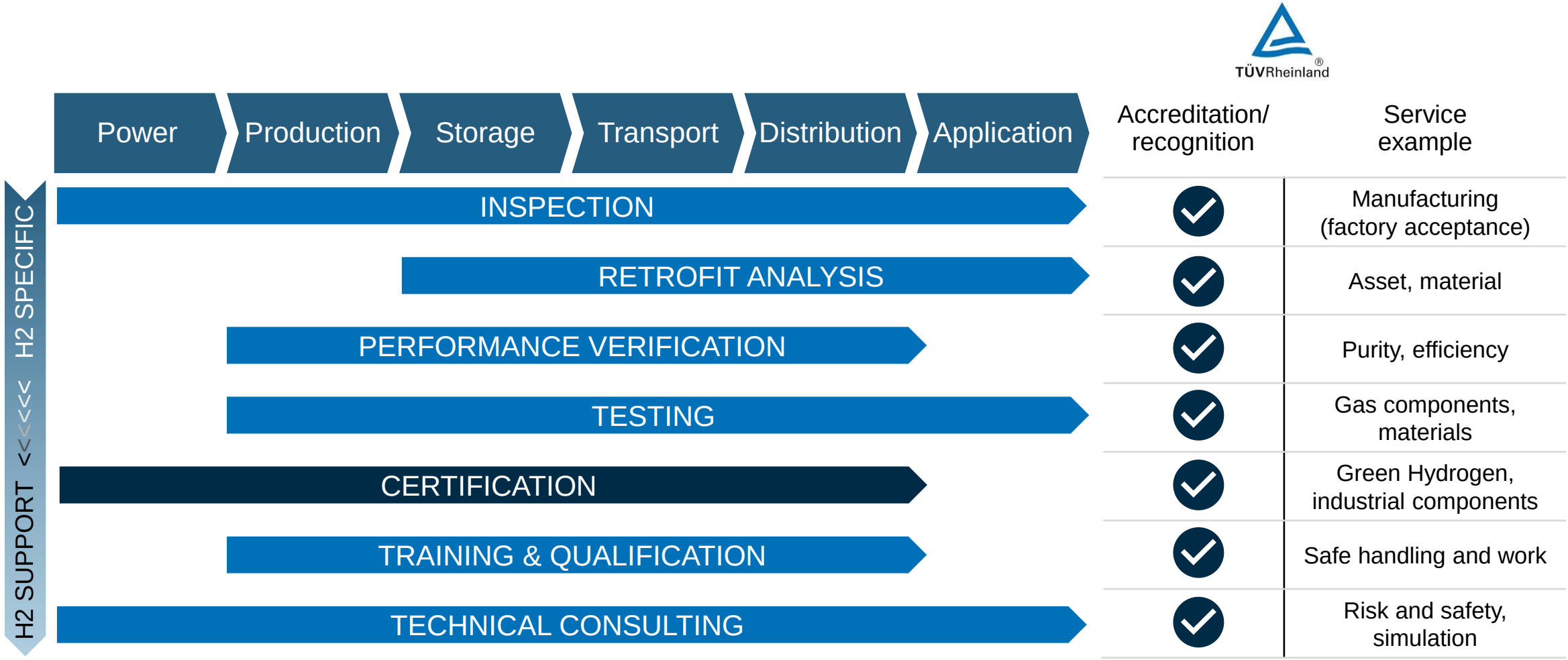
TÜV Rheinland’s TIC and consulting services along the H2 value chain



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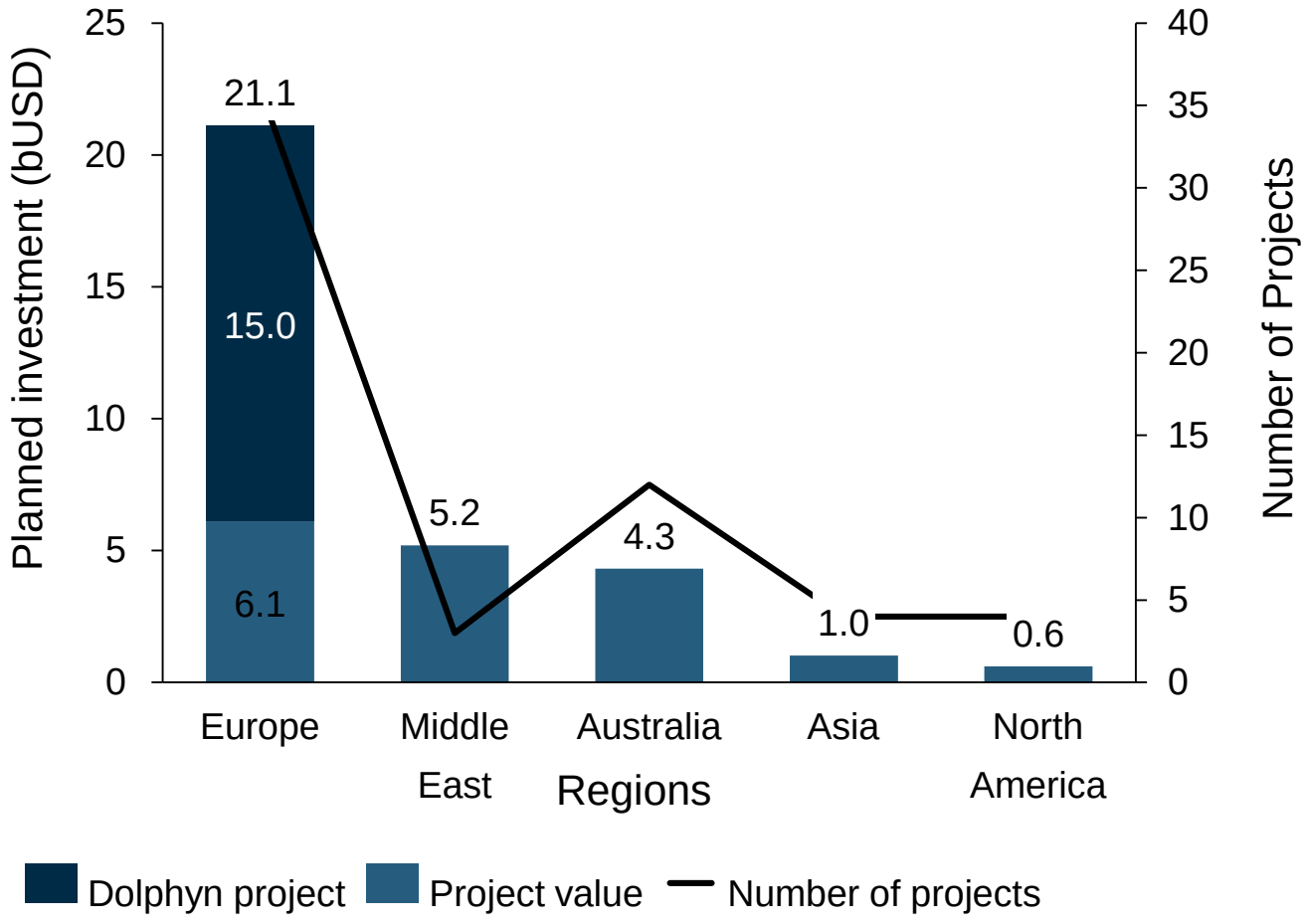
Az Egyesült Királyság Energiaipari Tanácsa 65 hidrogénprojektről számol be, amelyek első gyártása 2019-2030 között kezdődik



(Status August 2020)

Key insights

- A hidrogénenergia-ipari projektekbe történő befektetések fellendülnek, Európa pedig mind számában, mind mennyiségében a régió előfutára
- A zöld hidrogén termelés a fő hangsúly (78%)
- Szinte minden projekt kísérleti projekt

- A legnagyobb és legambiciózusabb projekt messze a 15 milliárd USD értékű Dolphyn projekt, amely Európa teljes beruházásának 71%-át teszi ki. Az ERM által működtetett és eredetileg a brit kormány által finanszírozott, lebegő tengeri szelet és tengervizet használva hidrogént állít majd elő, amelyet a szárazföldre szállítanak. A projekt 2 MW kapacitással indul (a tervezett kapacitás 1/5-e)

- Más régiókhoz képest a Közel-Keleten kevesebb, de magasabb értékű projekt van, míg Európában sok az alacsonyabb értékű projekt

- Ázsia magában foglalja Kína hidrogénenergia-projektjeit, és nem tartalmazza a japán és koreai technológiai projekteket. Észak-Amerika projektjei az Egyesült Államokban összpontosulnak.

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A hidrogénprojektek kihívásai

A hidrogéntechnológiák és -projektek számos kihívással néznek szembe

Összetettség / A technológia értékelése A jövőbeli stabilitásra vonatkozó döntések a beruházások és adók tekintetében

Technológiai integráció Hogyan integrálhatók a hidrogéntechnológiák a jelenlegi ipari struktúrákba?

Engedélyezés A szabályoknak, szabványoknak és engedélyezési eljárásoknak való megfelelés

Műszaki kockázatkezelés és biztosíthatóság Az üzemnek a munkavállalókra/környezetre vonatkozó kockázata

A szerkezetek, rendszerek és alkatrészek szabályzatoknak és szabványoknak **való megfelelése/megfelelősége**

Egészségvédelem és környezet Fenntarthatóság, kockázatértékelés és védelmi intézkedések

Személyzet Képesítés / kompetenciafejlesztés, képzés

Értékes hozzájárulás a biztonságos energiaátálláshoz:
TÜV Rheinland Hidrogén Kompetencia Központ különböző szakterületek szakértőivel

További információ a www.tuv.com/hydrogen oldalon található.

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Jó okok a TÜV Rheinland partnerként való választására

- **Aktívan részt vesz hidrogénszabványosítási** bizottságokban, helyi és nemzetközi hidrogénkonzorciumokban.
- **Több évtizedes projekttapasztalat** Németországban és külföldön a hidrogéntechnológiák, a megújuló energia, az energiahatékonyság, az infrastruktúra és a mélyépítés területén.
- **Erős szakértői csapatok** a különböző technológiai területeken, hogy minden kihívást leküzdhessenek.
- **Ismerjük a** különböző országok **helyi szabályozási követelményeit, hogy** biztosítsuk a jogszabályoknak, szabályzatoknak és szabványoknak való megfelelést az engedélyezéshez.
- **Hosszú távú hírnév a függetlenség és a pártatlan tanácsadás terén** ügyfeleink javára
- **Elkötelezettek vagyunk a** nyílt és együttműködő ügyfélkapcsolatok **kialakítása iránt**, és hosszú távú partnerként kívánunk működni.

European Clean Hydrogen Alliance

thyssenkrupp nucera

SHELL

Air Liquide

DB Energi

SIEMENS energy

RWE

VATTENFALL

Linde Hydrogen FuelTech

RheinEnergie

BES Berliner Erdgasspeicher

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Esettanulmányok

Az alábbi területekről:

- Gyártás, előállítás
- Tárolás
- Szállítás
- Felhasználás
- Fenntarthatóság

A bemutatandó videó elérhetősége:

https://youtu.be/YuEVhWpab58

Reference Cases: Several H2 Electrolysis Plants

Manufacturing, installation and commissioning of Megawatt size hydrogen electrolysis plants.
Extension up to 200 Megawatt (200.000 tons/y capacity) in progress

Client	Large Manufacturer
Location	Germany
Timeframe	2020 - ongoing
Main Service	Design exterminations, system approvals, Hazard analyses, explosion protection services, licensing & environmental services

Project Focus	▪ Safety operation – and CE conformity - assessment of the entire plant, integration and verification of the interfaces within the existing plants under operation; Check of conformity with reference to PED (pressure equipment directive),

Reference Case: Risk assessment of electrolysis hydrogen production system

We support our customer with risk assessment and improvement for the safe use of electrolysis hydrogen production system.

Client	Supplier of energy system
Location	China
Timeframe	2021 - ongoing
Main Services	Integrity management services for pressure type alkaline water electrolysis hydrogen production system

Project phases	▪ Phase 1: Gap analysis and risk assessment(HAZOP, HAZID) of electrolysis hydrogen equipment and system ▪ Phase 2: Optimization and improvement of safety compliance ▪ Phase 3: Safety risk control and equipment safety compliance audit and certification

Reference Case: Hydrogen Electrolyser HAZOPs, LOPAs, DSEAR

HAZOP study, LOPA, DSEAR for electrolysis plant including electrolysers and associated equipment

Client	Large Electrolyser manufacturer
Location	UK
Timeframe	2021
Main Service	Hazard and Operability (HAZOP) analysis Layers of Protection (LOPA) analysis Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) analysis Hazardous Area Classification (HAC),

Project focus	▪ Facilitation of HAZOP study including producing briefing note, chair and scrip HAZOP workshop and deliver HAZOP study report detailing the study findings. ▪ DSEAR assessment for Hydrogen electrolyser laboratory. Including HAZID, development of hazard register, and consequence assessment ▪ HAC for Hydrogen electrolyser laboratory, zone extent calculations for test stations and associated equipment ▪ HAZOP and LOPA for containerised electrolyser plant, LOPA for all applicable hazards identified within HAZOP.

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Reference Case: H_2 Electrolyser and filling plant

The project included the testing and initial commissioning test of an H2 electrolyser, three H2 compressors, hydrogen storage and dispenser (refuelling of buses).

Client	AWG Wuppertal
Location	Wuppertal
Timeframe	2019-2021
Main Service	Functional safety assessment.

project focus	Wuppertal has been a hydrogen model region since 2020 with local cooperation from AWG, Wuppertal municipals (WSW) and local stakeholders. AWG generates hydrogen by electrolysis at its waste-to-energy plant in Wuppertal region. 10 fuel cell buses and a hydrogen refuelling station from WSW were put into operation in 2020. Project scope: ▪ Testing of the process control technology (Measurement, control and regulation technology) ▪ Hardware and software integrity assessment ▪ Technical function test ▪ Relevant standard DIN EN 61511

Reference Case: H_2 Electrolyser

The project involved testing the world's largest prototype PEM electrolyser to date, with a rated output of 1 MW, followed by a field test at E.ON's Hamburg-Reitbrook site.

Client	E.ON
Location	Hamburg-Reitbrook
Timeframe	2015
Main Service	Assessment of the overall system for compliance with the relevant standards and directives for placing the system on the market.

project focus	▪ Testing of the explosion protection ▪ Testing of the process control technology (Measurement, control and regulation technology) ▪ Electrical safety ▪ Technical support ▪ Testing of modifications to the software (during operation) ▪ Relevant standard DIN EN 61511

Reference Case: H_2 Electrolyser

The project includes conformity assessment on a hydrogen electrolyser (AEL process / atmospheric or pressure-driven with 30 Nm³/h H2). Manufacturer: ENERTRAG HyTec GmbH (Model HDE-05)

Client	Brandenburg University of Technology Cottbus (H2 test stand)
Location	Germany
Timeframe	2012
Main Service	Notified body during manufacture, commissioning according to BetrSichV as ZÜS

project focus	▪ Examination of conformity with reference to the PED (Pressure Equipment Directive) as well as other relevant EU directives incl. CE conformity assessment of the entire system (assembly)

Reference Case: H_2 Electrolyser

The project comprised the testing of a PEM electrolyser with a nominal electrical output of 250 kW.

Client	hydrogenics
Location	Scotland, UK
Timeframe	2017
Main Service	Evaluation of the hardware integrity of the PLT technology (MSR)

project focus	▪ Testing of the process control technology (Measurement, control and regulation technology) ▪ Relevant standard IEC 61511

Reference Case: H_2 Electrolysers

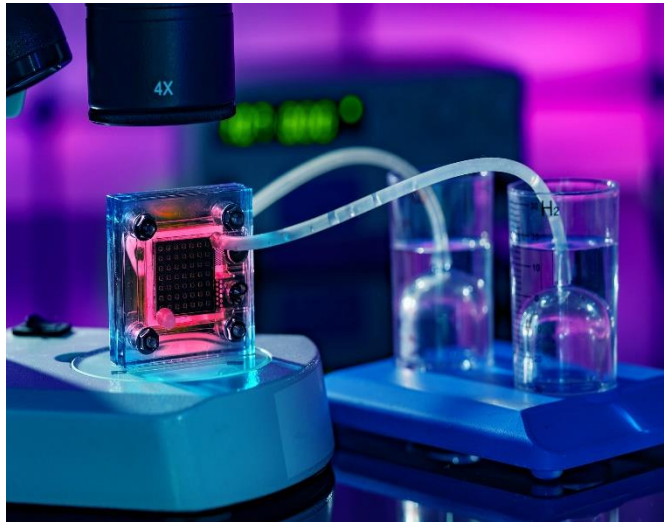
The project comprised the testing of PEM electrolysers and subsequent practical testing.

Client	Fraunhofer Institute
Location	Freiburg, Germany
Timeframe	2018, nominal power 1 MW 2019, nominal power of 200 kW (test bench)
Main Service	Functional safety assessment.

project focus	▪ Testing of the process control technology (Measurement, control and regulation technology) ▪ Technical support ▪ Relevant standard DIN EN 61511

Reference Case: Quantitative and Occupied Building Risk Assessment

Refuelling station, hydrogen storage facility expansion QRA (quantitative risk assessment) & OBRA (occupied building risk assessment).



Client	Large Gas supplier
Location	Aberdeen, UK
Timeframe	2021
Main Service	QRA (quantitative risk assessment) & OBRA (occupied building risk assessment).

Project focus	▪ Quantitative Risk Assessment, including consequence modelling, frequency analysis and calculation of risk generated by individual proposed modifications. ▪ Occupied Building Risk Assessment to assess the impact of the proposed Hydrogen storage facility on occupied buildings.

Reference Case: Cavern Storage Project

The project comprises investigations of different scenario-based release situations including the associated effects (e.g. free-jet fire)

Client	STORAG ETZEL GmbH
Location	Rüdersdorf near Berlin
Timeframe	2022
Main Service	Effects of releases/incidents for two planned cavern storage facilities with the storage medium compressed hydrogen

project focus	▪ Estimation of the effects to be expected in the worst case in the event of a design basis accident (blowout) ▪ Impact studies on scenario-based failure traps (blowout) at the hydrogen caverns ▪ Normative bases among others: TRGS 407

Transportation

Reference Case: Pilot project for H2/natural gas-mix in existing distribution networks

TÜV Rheinland investigates which technical and structural requirements must be achieved to use hydrogen safely in households. The proportion of hydrogen in the natural gas distribution network is increased stepwise and the integrity of the existing gas appliances and boilers tested.

Client	German Distribution Network Operator
Location	Germany
Timeframe	2021 - 2022
Main Service	• Control of the network configuration, calorific value measurement Determination of permeation/leakage, gathering of operational experience • Determination of technical and construction requirements for all materials in the distribution network and existing gas appliances

Project Phases	• Phase I Project initiation / evaluation data • Phase II Preliminary work for operation with 20% hydrogen • Phase III Conversion to operation with 20% hydrogen • Phase IV Monitoring of the plants in operation 20% hydrogen • Phase V Conversion to operation with L- or H-gas • Goal: Gradually increase the percentage of hydrogen in the distribution network and create the conditions for safe operation with pure hydrogen.

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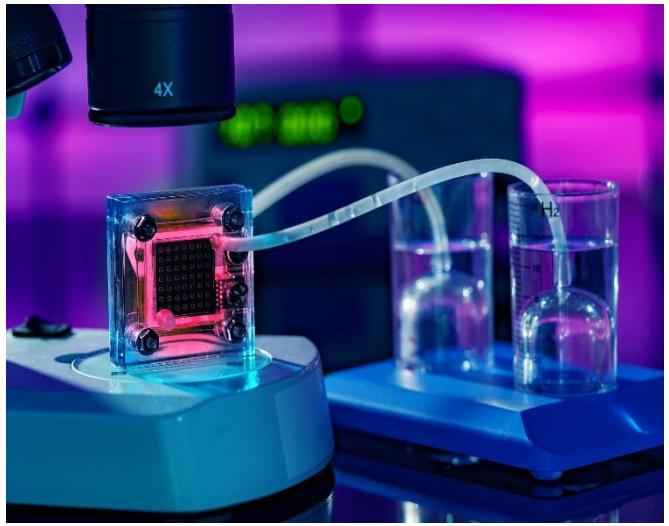
Transportation

Reference Case: Hydrogen Process LOPA Analysis and Consequence Modelling

Technical safety studies and Physical effects consequence modelling



Client	Heavy Engineering company
Location	Renfrew, UK
Timeframe	2020
Main Service	LOPA analysis for low carbon bulk hydrogen supply pilot project of n enhanced steam reforming process.

Project focus	▪ LOPA study to demonstrate that the hazard preventive and mitigation controls in place are sufficient to reduce the risk to an acceptable level. ▪ PHAST modelling to determine consequences of a flange leak on a hydrogen pipeline for a pilot project at Cranfield University.

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Application

Reference Case: Participation in the expansion of a hydrogen infrastructure.

The framework agreement between TÜV Rheinland and a German operator of hydrogen stations was extended to expand the filling station network for H2-cars as well as for heavier commercial vehicles and to integrate the hydrogen stations into existing filling infrastructure.

Client	Installers & operators of hydrogen filling stations in Germany
Location	Germany
Timeframe	2020 – 2022 (collaboration started in 2017)
Main Service	• Approval to commissioning of H2 filling stations • First periodic inspection of the existing installation
Project focus	▪ Expansion of the German filling station network for H2 cars as well as for other heavier commercial vehicles ▪ Commissioning of 100 hydrogen filling stations in 7 German conurbations (Hamburg, Berlin, Rhine-Ruhr, Frankfurt, Nuremberg, Stuttgart and Munich) as well as along the connecting trunk roads and highways ▪ Preferably integration of hydrogen stations into existing filling stations

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Application

Reference Case: Safety Support for hydrogen fuel cell development program.

We supported our customer with a package of different services to safely advance his hydrogen fuel cell development program.

Client	German supplier of diesel engines, drive and energy systems
Location	Western Europe and North America
Timeframe	2003 - 2018
Project focus	Safety support for MW scale pressurized hydrogen fuel cell development including test rigs, facilities and product demonstrators.

Main Service	A variety of different technical consultancy support and safety studies were employed over the years to support the client's hydrogen fuel cell development program: ▪ HAZOP, HAZID ▪ Hazard logs, Safety Documentation Review ▪ DSEAR/ATEX Assessments ▪ RAM Studies, SIL Assessments ▪ Area Electrical Classification Assessment ▪ Training, Safety Manager Secondmen

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Reference Case: Procurement of trains powered by hydrogen fuel cells

TÜV Rheinland successfully supports the Rhine/Main Regional Transport Association (RMV) in supplying and ensuring the long-term availability of 27 multiple unit trains with hydrogen fuel cell drive.

Client	Rhine/Main Regional Transport Association (RMV)
Location	Rhine/Main area (Frankfurt)
Timeframe	2017 – 2020
Main service	▪ Preparation of essential parts of the tender documents (technical, operational, economic) ▪ Active accompaniment of the entire process
Project focus	▪ Important milestone for the reduction of pollutant emissions in the promotion of regional rail passenger transport (SPNV) in the Rhine/Main region ▪ New vehicles will replace the previous diesel-powered trains on various lines from the 2022/2023 timetable change ▪ Future-proof solution through an "availability model" in which manufacturers are responsible for the availability of the vehicles – including maintenance, refueling system and hydrogen availability – during the entire service life

Reference Case: Desktop Safety Review Hydrogen Refueling Station

Independent review and verification

Client	Oil and Gas Major
Location	Western Europe and North America
Timeframe	2020
Main Service	Facilitation and report of Desktop Safety Review Hydrogen Refuelling Station design.
Project focus	▪ Technical Desktop Safety Review for Hydrogen Refuelling Station. ▪ Identification of process/technical HSE risks. ▪ Investigation to determine if risk barriers are adequate to manage risk to ALARP levels.

Reference Case: Filling station network of the future.

The framework agreement between a German operator of hydrogen stations and us was extended by a further 2 years. The aim is to further expand the German filling station network for H2 cars as well as for heavier commercial vehicles and to integrate the hydrogen stations into existing filling stations.

Client	Installers & operators of hydrogen filling stations in Germany
Location	Germany, various Cities
Timeframe	2003 - 2018
Main Services	▪ We accompany the project from consulting to approval to commissioning of H2 filling stations ▪ Acceptance of approx. 65 H2 filling stations in Germany ▪ First periodic inspection of the existing installation
Project focus	▪ Expansion of the German filling station network for H2 cars as well as for other heavier commercial vehicles ▪ Commissioning of 100 hydrogen filling stations in 7 German conurbations (Hamburg, Berlin, Rhine-Ruhr, Frankfurt, Nuremberg, Stuttgart and Munich) as well as along the connecting trunk roads and highways ▪ Preferably integration of hydrogen stations into existing filling stations

Reference Case: Development of a rail-specific standard for hydrogen applications

Separate technical regulations and standards are to be drawn up for the approval of hydrogen-powered rail vehicles in order to simplify the implementation and approval process for hydrogen and fuel cell technology in rail vehicles.

Client	German Centre for Rail Traffic Research (Deutsches Zentrum für Schienenverkehrsforschung (DZSF)), Eisenbahn-Bundesamt (EBA)
Location	Germany
Timeframe	The project is designed to last 12 months and will run until fall 2021
Main Service	▪ Promoting and sustainably strengthening the use of alternative drive systems in rail traffic
Project Focus	▪ Preparation of technical regulations and standards for the approval of hydrogen-powered rail vehicles, including safety concept

Application

Reference Case: Safety Studies for Hydrogen Bus Depot

DSEAR Risk assessment for introduction of hydrogen powered bus servicing activities to existing sites

Client	Building Consultancy
Location	Walsall, UK
Timeframe	2021
Main Service	Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) analysis Hazardous Area Classification (HAC) Hazard Identification (HAZID)

Project focus	▪ Safety studies delivering a DSEAR risk assessment, including HAZID and Hazardous Area Classification (HAC) for servicing and a separate venting operation assessment.

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Reference Case: VinnoMiR - Preparation of the use of innovative SPNV vehicles.

Together with a solicitor's office TÜV Rheinland supports ZVNL in its comprehensive investigation into the use of alternative drive systems in regional rail transport (SPNV) operations in the Central German Territory.

Client	Special Purpose Association for the Leipzig Public Transport Area (ZVNL)
Location	Germany, Saxony (Leipzig)
Timeframe	Implementation in 2025
Main Service	Investigation of the feasibility of an SPNV operation with innovative vehicles: ▪ Analysis of legal, safety-specific and organizational aspects ▪ Derivation and discussion of site-specific procurement methods
Project Focus	▪ Integration of the current diesel line RB110 (KBs 506) into the S-Bahn network ▪ Operation of the predominantly non-electrified line with trains and alternative drive trains (hydrogen or battery operation), instead of with the previous diesel multiple units

Reference case: Green Ammonia / Hydrogen Certification

We support a renewable energy firm to assess the concept engineering for their green ammonia project in Oman and certify green ammonia based on TÜV Rheinland standard

Client	A leading renewable energy firm
Location	Oman
Timeframe	2022
Main Service	Phase I: Assessment of concept engineering for green ammonia production project (Ongoing) Phase II: Green hydrogen certification (2023)

Project focus	The client is planning to produce Green Ammonia through Green Hydrogen generated by electrolysis fed by solar energy; Project phase I refers to certification of Green Ammonia, which covers below work scope: ▪ Assessment of completeness, consistency and plausibility of documents for the green field plant ▪ Remote audit ▪ Assessment and calculation of Ammonia PCF ▪ Assessment of annual portion of Green Ammonia ▪ Certification of Green Ammonia

Köszönjük figyelmüket

Geszti Sándor

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