CONSULTING ENGINEERS

## CAPABILITY STATEMENT

# HYDROGEN PRODUCTION, STORAGE AND TRANSPORT

2022

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# 1 GROUP PROFILE & PHILOSOPHY

## GROUP PROFILE

The ILF Group is an international engineering and consulting firm that has been helping its clients successfully execute technically demanding industrial and infrastructure projects for **more than 50 years**.

With **2,000 highly qualified employees** at **more than 40 office locations** across five continents, the companies of the ILF Group have a strong regional presence.

This enables ILF to interact with clients and project parties on site. At the same time, close cooperation within the network of the ILF Group makes it possible to draw on international experts and make use of their special experience, processes, and tools.

The combination of local presence and international expertise ensures that client needs are met in the best possible way. The company is privately owned by the founding families and is therefore completely independent. It has no affiliation with manufacturers, suppliers, or financial institutions.

*"ILF combines local presence and international expertise to best serve clients´needs."*

Klaus Lässer, CEO

### ILF's main business areas are:

- Energy & Climate Protection
- Water & Environment
- Transportation & Urban Spaces
- Oil, Gas & Industrial

## VISION, VALUES & BELIEFS

At ILF, we passionately devote our energy to pursuing the vision of improving the global quality of life. This is what drives us and makes us believe in our work.

We are motivated by our ambition to achieve market leadership through quality. This is why we focus on a structured approach to problem solving and constantly strive to improve. But above all, it is our great people that really make the difference. We truly believe in respect, honesty, reliability and fairness as a solid foundation for all our interactions.

We continue to spearhead Engineering Excellence. Our independence allows us to provide creative solutions while continuously acting in every client's best interest.


# 2 PROFESSIONAL COMPETENCE IN HYDROGEN

To meet the climate targets of the Paris 2015 Agreement, by further decreasing the $CO_2$ emissions, it is necessary to increase the share of renewable energy in the energy mix and to replace fossil fuels in the industry at a progressive rate. Hydrogen can be produced by using only renewable energy and, therefore, can be seen as an environmentally friendly fuel and power alternative. Furthermore, it has the great advantage that it cannot only be used as a long-term storage solution for electric power but also as a feedstock for the industry or as fuel for mobility.

Hydrogen related projects are well known to ILF, as it is part of ILF's pipeline, refinery and petrochemical plant business for over 20 years. Particularly ILF's long term experience in the design of facilities as well as pipelines is a valuable basis for the design of electrolyser plants as well as hydrogen transport and storage solutions.

ILF has extensive experience in the engineering of the entire hydrogen value chain, including the design of renewable electricity generation, water treatment/ desalination, hydrogen production, storage, and transport.

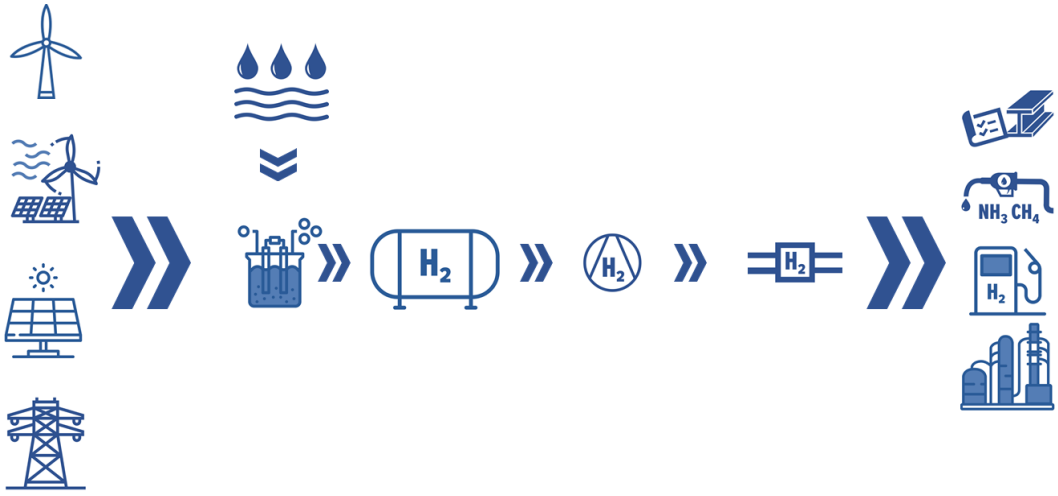
## PROJECT HIGHLIGHTS

- DEMO4GRID - Owner's Engineer performing concept design, permitting, as well as detailed design for MPREIS Austria for a 4 MW Electrolyser facility, $H_2$ storage facilities, as well as an $H_2$ refuelling station
- 20 GW Hydrogen Production and Ammonia Export - ILF is working on a concept design for a green hydrogen production project in Kazakhstan including desalination and ammonia synthesis plant. Furthermore, existing infrastructure and export options are evaluated as part of this project scope.
- ELEMENT EINS - Feasibility Study for Gasunie/ TenneT/ Thyssengas, Germany for a 40 MW – 100 MW Power-to-Gas facility including electrolyser plant, Methanation, $H_2$ pipeline, as well as $H_2$ injection into the existing gas network

- H2.Ruhr - Feasibility study on a hydrogen value chain including ammonia important terminal, ammonia cracker, hydrogen pipeline and a 100 MW electrolysis plan with the goal of supplying 80.000 t of green hydrogen to off-takers in the Ruhr area of Germany.
- Engineering of 10 MW electrolysis plant in Lower Saxony - For an alkaline 10 MW electrolysis plant at a client's site, one of the most known electrolyzer manufacturers commissioned ILF for the Basic and Detail Engineering works including the deionized water distribution system, the intercooling circuit and the electrolyte system.
- Permitting of 5 MW electrolysis - In this project ILF is responsible for coordination, compilation and submission of permitting documentation according to German immisson law (BImSchG) for a 5 MW electrolysis plant with trailer filling station.
- Hydrogen underground storage - Concept Design and Basic Engineering for the above ground facilities of a hydrogen underground storage. This covers the engineering of all relevant engineering disciplines, including a compression station and a hydrogen treatment unit.
- ELTEN COMPRESSOR STATION - Feasibility Study investigating the implications on machinery, balance of plant, and pipeline when mixing hydrogen to the existing natural gas system.

## ADDED VALUE

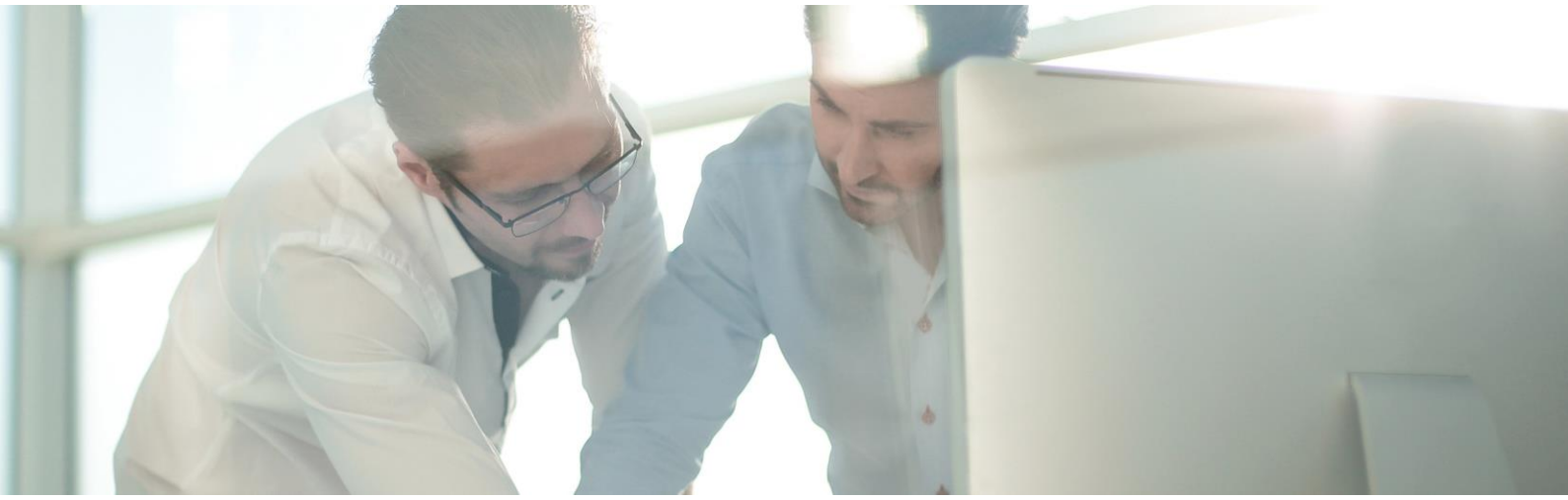
- First-class experience in $H_2$ facility design – successful development and implementation of significant and reputable feasibility studies as well as detailed design including permitting design of electrolyser facilities
- First-class expertise in the design of $H_2$ pipeline systems, based on the long history of designing oil & gas pipeline systems
- Full-Service Provider – interdisciplinary and fully integrated development of hydrogen projects providing comprehensive solutions by
  - » Providing experienced staff resources with in-house experts in the hydrogen sector and the option to adjust the size of project teams by drawing on the expert pool of the ILF Group of about 2,000 employees
  - » Managing all interfaces with suppliers and other project stakeholders
  - » Consistent continuity and reliability of the involved project teams as well as high flexibility
  - » Close cooperation on special topics with associated experts and long-term partners
- Proven project and engineering execution methodologies from the oil and gas sector with the flexibility to adapt these to the innovative and fast progressing market of hydrogen related projects
- Complete independence with no affiliation to construction companies, suppliers or financial institutions
- Integration of detailed engineering and project implementation know-how into early project development phases, focusing on unlocking the maximum value of the project



# 3 FIELDS OF EXPERTISE

Design for the entire value chain of hydrogen production, storage and transportation facilities. This scope includes:

- **Renewable power generation**
  - » Photovoltaic power plants
  - » Wind farms
  - » Hydropower plants
- **Water treatment and transmission**
- **Electrolysis**
- **Gas treatment**
- **Gas storage**
  - » Pressurised tanks
  - » Underground gas storage facilities
- **Hydrogen refuelling stations**
- **Conversion to power**
- **Conversion to chemicals**
  - » Methanation
  - » Power-to-X
- **Transport via pipeline systems**
  - » Pipelines for hydrogen/ natural gas mixtures or pure hydrogen
  - » Compressor stations
  - » Hydrogen injection facilities
- **Marine applications**
- **Heat integration**
- **Nitrogen generation**
- **Ammonia production**



# 4 SERVICES

ILF renders all services required to successfully implement hydrogen-related projects in all project phases. ILF may act either on the project owner's side or on the contractor's side and provides independent and multidisciplinary engineering solutions.

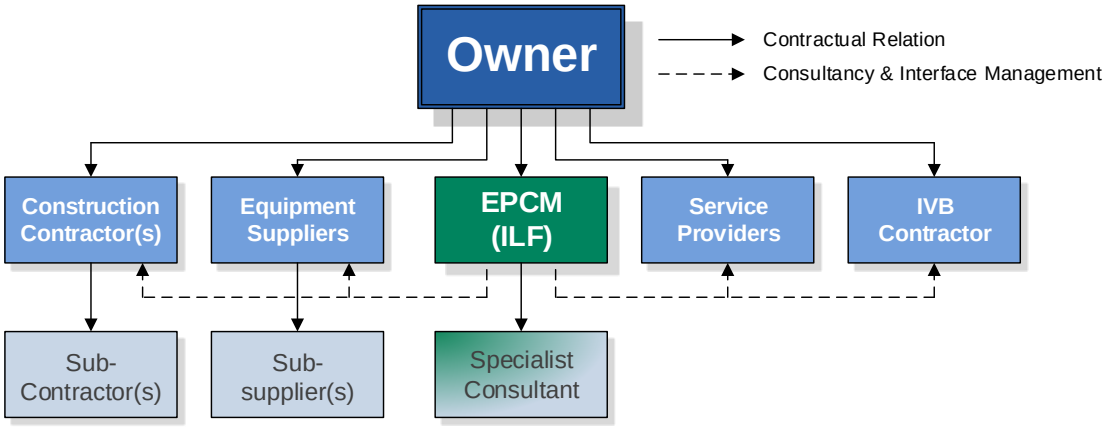
ILF's project services for hydrogen facilities and pipelines can be segmented into several groups and are performed in accordance with state-of-the-art engineering methodologies.

## ILF AS OWNER'S ENGINEER

- **Conceptual Engineering** including **Feasibility Studies** and **Concept Design** with system and technology option selection assessments including techno-economic risk analysis, preliminary facilities site and pipeline routing studies.
- **Basic Engineering / pre-FEED** to define the main process engineering activities and further detail the selected system and key technologies/equipment for $H_2$ facilities. This also includes the development of the main plot plan(s) and overall system structure/architecture of instrument & control as well as electrical engineering. Also, the permitting strategy is defined and an update of the financial model, including scope typical Class 3/4 cost estimations according to AACE standards performed.
- **Front-End-Engineering-Design (FEED)** to further develop Basic Engineering/pre-FEED to the details required by clients to sanction the project/make the Final Investment Decision, as well as allowing a first approach to permitting authorities. This typically comprises the final update of the financial model including scope typical Class 2/3, cost estimations according to AACE standards by preparation and floating of Long Lead Items (LLI) and/or EPC tenders, all required execution strategies and plans, HSSE studies, workshops and assessments, a full set of design philosophies, and a 30% 3D model.

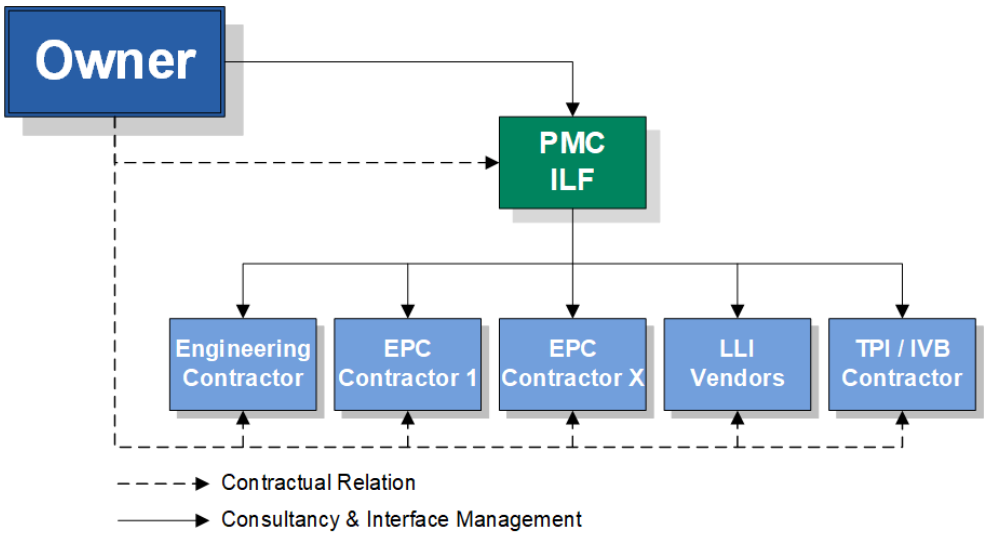
## ILF AS EPCM CONTRACTOR & CONTRACTOR'S ENGINEER

- **Detailed design** to enable a physical project execution, including authority approvals. This includes material requisitions, functional specifications, guide drawings, and allother engineering documents to a level of detail that allows placement of orders to respective providers and submittal of permitting documentation to relevant authorities. Thereafter, technical support to the procurement process, including Vendor Design Vetting, as well as engineering support to the construction and commissioning teams, will be provided.
- **Procurement Support** to supplement the client's procurement and contracts management teams with additional resources and competencies by taking over the entire procurement management or of selected individual packages.
- **Construction, Commissioning & Start-up Supervision** to organize and coordinate all activities or of selected work packages on-site until system handover. This includes the witnessing of factory and site acceptance tests (SAT & FAT), performance and reliability tests, as well as the initial operations phase.



## ILF AS PROJECT MANAGEMENT CONSULTANT / CONTRACTOR (PMC)

- Performing full project management on behalf of the client, integrated into client's team or execution of individual services packages. This may include contracts, claims and risk management, project controls, supply chain management support, engineering supervision as well as construction & commissioning supervision.




## ILF AS CONSULTANT FOR INVESTORS, SHAREHOLDERS & FINANCERS

- Due Diligence Studies
- (Bankable) Feasibility Studies

## ADDITIONAL SERVICES RELATED TO HYDROGEN PROJECTS

- Technical safety studies
- Venting/blowdown studies
- Heat radiation and gas dispersion calculations
- Hazardous area calculations
- Study of overall energy integration
- Upgrade and modification studies
- Optimization of pipeline systems
- Site selection studies and pipeline routing
- Noise studies

# 5 CONTACT

## CONTACT PERSON

ILF will be pleased to assist you with your projects and challenges.

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## FURTHER INFORMATION

To learn more about us, please visit **www.ilf.com**

# 6 PROJECT HIGHLIGHTS

Please find below a selection of reference projects. To further confirm ILF's capabilities, a comprehensive references list as well as our selected references will be made available upon request.

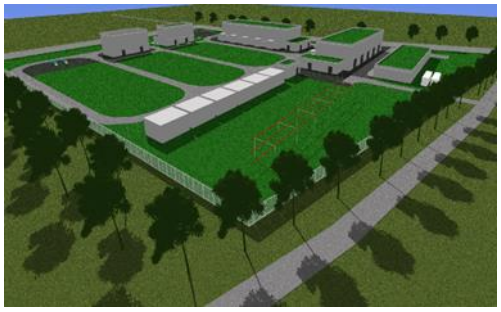
**The Demo4Grid Hydrogen Project**

Hydrogen is used for heating the MPREIS production facilities as well as being utilized in a refueling station for truck refuelling. In the next phase, energy shall be supplied from a renewable source, i.e. hydropower plant in the vicinity.
Main services: Conceptual and Detailed Design (EPCM) | Procurement Services | Construction Supervision.

**20 GW Hydrogen Production and Ammonia Export**

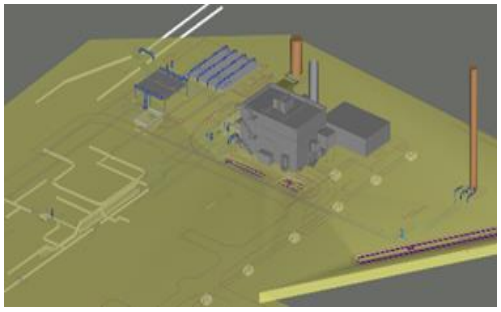
ILF is working on a concept design for a green hydrogen production project in Kazakhstan including desalination and ammonia synthesis plant. Further-more, existing infrastructure and export options are evaluated as part of this project scope.
Main services: Conceptual Design

**Element Eins: 40 - 100 MW Power-to-Gas Plant**



Aim of the project is to link electricity and gas grids with a large-scale power-to-gas plant as part of the "ELEMENT ONE" project. This industrial sized plant will allow the coupling of wind energy in the north of Germany with various sectors such as gas transport, mobility and other industries.
Main services: Feasibility Study

**Extension Compressor Station Elten**



As part of the overall project of integrating a new compressor into the existing facility, ILF has been tasked to investigate the implications of mixing certain vol% of hydrogen to the existing natural gas system. As a result of this investigation the client decided to consider up to 10 % H2 and the extension of the compressor station is now designed to handle this mixture.
Main services: Conceptual Study

# Green Hydrogen

## List of References

18/05/2022

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## INTRODUCTION

ILF is an internationally operating, independent engineering and consulting company with more than 40 offices worldwide on five continents. Since 50+ years, ILF supports the realization of renowned industrial and infrastructure projects. More than 2 400 employees develop and realize international project solutions for clients in the business areas energy and climate protection, oil, gas and industrials, water and environment, transport and structures (www.ilf.com). ILF executes consulting, engineering and project management services from project concepts via design, permitting and construction to commissioning as well as operation, extension or decommissioning of plants.

ILF's engineering expertise covers the entire hydrogen value chain and offers solutions for a large spectrum of hydrogen-related projects. This includes the design of renewable electricity generation, water treatment and desalination, hydrogen production and hydrogen storage, as well as transport and conversion to other products such as ammonia and methane.

Our added value in the hydrogen field stands out for its: (a) First-class experience in H2 facility design – successful development and implementation of significant and reputable feasibility studies up to the GW scale, as well as detailed design including permitting design of electrolyzer facilities, (b) First-class expertise in the design of H2 pipeline systems, based on the long history of designing oil & gas pipeline systems, (c) Full-Service provision of comprehensive solutions for interdisciplinary and fully integrated hydrogen systems.

ILF renders all services required to successfully implement hydrogen projects. These services include amongst others:

• Roadmaps, master plans, energy system planning, site selection studies, due diligences for early phase development of hydrogen facilities.
• Conceptual Engineering including Feasibility Studies and Concept Design with system and technology assessments.
• Basic Engineering / FEED to define the main process engineering activities and further detail the selected system and key technologies/equipment for H2 production facilities.
• Detailed Design to enable a physical project execution, including authority approvals.

ILF's project highlights include:

• Demo4Grid, an Austrian-based project funded by the European Union to demonstrate the economic viability of an alkaline electrolyzer for grid balancing services. ILF is the owner's engineer, supporting the client MPREIS in the concept and detailed design phases, as well as at permit planning, construction, and commissioning.
• H2.Ruhr, a feasibility study for a 100 MW hydrogen and ammonia production plant to supply industrial customer in German Ruhr area via pipeline.
• Several studies for pipeline operators to investigate the technical feasibility of injecting different amounts of hydrogen into their existing pipeline system, including a detailed investigation of the compressor stations and all involved components.
• EU funding applications support. ILF is currently supporting the H2 push boat project for Greenplug (IPCEI) and has also supported the LOTOS refinery in the Polish funding round of the IPCEI application (100MW electrolysis + integration into refinery).

| Project | Service | Client | Countries | Execution Period | Purpose | Description |
|---|---|---|---|---|---|---|
| 100 MW Hydrogen Electrolysis Plant Lower-Austria | Conceptual Study | confidential | Austria | 2022 - ongoing | Mobility \| Pipelines \| Power to gas \| Filling stations \| Refineries | Leading Austrian industrial companies are intending to build a large-scale electrolysis plant (100 MW) for the production of green hydrogen. The plant will primarily supply a refinery, while the surplus will be used in mobility. For this purpose, a connecting pipeline between the electrolysis plant and the refinery, as well as a filling station are planned. The objectve of the study is the preparation of AACE class 5 investment cost estimate and includes: Site evaluation, technology assessment, CAPEX / OPEX cost estimate, preparation of permitting concept, and preparation of an implementation concept including project schedule. |
| Green Deal | Concept Engineering & FEED | Energinet | Denmark | 2022 - ongoing | Pipelines \| Underground storage \| Ammonia | Concept and FEED engineeing services for transmission, storage and usage of green gases projects including hydrogen. ILF is among three companies awarded. Volume of CAPEX estimated at over 1 billion Euro |
| Tiwi islands Green Hydrogen Export Project | Environmental review | GEV | Australia | 2022 - ongoing | Export | Client is developing a GW scale hydrogen production plant based on solar photovoltaic for the export as compressed hydrogen to other countries. ILF has been awarded to provide technical support for the environmental referral process. |
| Hydrogen production and filling plant Pfeffenhausen | Authority Engineering | Hy2B | Germany | 2022 - ongoing | Mobility | Client is erecting a 5 MW hydrogen production and filling plant in the hydrogen region HyBayern, which is developed by the districts of Munich, Landshut and Ebersberg. ILF has been awarded to compile and submit the documents for the immission control permit in the administrative district of Lower Bavaria. |
| Konin Green Hydrogen production facility | Feasibility Study | Prosperous Partners | Poland | 2022 | Mobility | The project concerns a feasibility study for a 50 MW electrolysis plant for the transport sector. The electrolysers are combined with 500 bar compressors and trailers to transport the H2 to refuelling stations. ILF was awarded with the application for the Innovation Found. |
| 20 - 30 GW Hydrogen Production + Desalination + Ammonia Production | Concept Engineering | Svevind | Kazakhstan | 2021 - ongoing | Ammonia production and export | ILF has been awarded the contract for the concept design of this Gigascale (up to 30 GW) green hydrogen production project including desalination and ammonia production. Furthermore, existing infrastructure and export options are evaluated as part of this project scope. |
| H2.Ruhr - Electrolysis, Ammonia Import and Hydrogen Pipeline | Consulting | Westnetz | Germany | 2021 - ongoing | Ammonia import and transport | Three of the biggest European utility companies together with ABB and SAP are working together to build an industrial value chain for green hydrogen to serve the European market. The German part of the project, called H2.Ruhr, involves the construction of a regional hydrogen pipeline infrastructure with direct connection to a wide range of consumers in the Ruhr area. Through H2.Ruhr, up to 80,000 tons of green hydrogen and green ammonia per year will be supplied to customers in the Ruhr region. ILF has developed the overall project time schedule and is working on the feasibility study required for the application for innovation fund. |
| 10 MW Electrolysis and Hydrogen Refuelling Station | Concept Engineering | Motor Oil | Greece | 2021 - ongoing | Refueling Stations \| Refineries | Concept Study including Technology Selection and Location Study for a 10 MW electrolysis plant. The produced green H2 will be either directly used for hydrogenation processes within the refinery or delivered to the closest HRS. The concept for the HRS and the container filling and unfilling stations is also included. |
| 10 MW Electrolysis plant, Lower Saxony | Basic and Detailed Engineering | Sunfire | Germany | 2021 - ongoing | Power to gas | For an alkaline 10 MW electrolysis plant at a client's site, one of the most known electrolyzer manufacturers comissioned ILF for the Basic and Detail Engineering works concerning the deionized water distribution system, the intercooling circuit and the electrolyte sytem. Furthermore, the piping and cable planning is also to be carried out by ILF. |
| H2 Assessment of Romania Gas Pipeline | Study | Kalyon | Romania | 2021 - ongoing | Pipelines | Technical Study of Transgas pipeline system design for handling hydrogen-natural gas admixtures. |
| Hydrogen Underground Storage | Feasibility Study and Basic Engineering | confidential | Germany | 2021 - ongoing | Storage | Concept Design and Basic Engineering for the above ground facilities of a hydrogen underground storage. This covers the engineering of all relevant engineering disciplines, including a compression station and a hydrogen treatment unit. |
| 10 MW Electrolysis plant, Salzburg | Concept, Basic, and Detailed Engineering \| Construction & Commissioning Supervision. | Salzburg AG | Austria | 2021 - ongoing | Power to gas \| Heating \| Refueling Stations | Construction of an H2 generation plant with electrolyser, pressure storage tank and compressor, refueling station and filling station for transport trailers, as well as a natural gas grid feed-in (blending). Includes waste heat utilization from the electrolyser and compressor plant into the existing district heating network by means of a heat pump. |
| Development pathways for hydrogen hubs | Consultancy | IADB | Chile | 2021 - ongoing | H2 Production and Export | The study aimed following objectives: 1) Determine possible pathways for the hydrogen hubs in Chile, including the required infrastructure, and installations, and resources. 2) Describe the macroeconomic impacts of the development of green hydrogen ineach hydrogen hub. 3) Outline local challenges arising from the development of the hydrogen hubs. 4) Recommend actions to local and national government entities to mitigate the risks arising from the outlined challenges, as well as to capture the outlined opportunities for local development. |
| $H_2$ Breisgau-Hochschwarzwald | Technical advisory services | Endura Kommunal | Germany | 2022 | Power to gas \| Refueling Stations \| Refilling Stations | The goal of the project is to develop a feasible business case for a hydrogen generation plant with hydrogen filling and refueling station in the area of Breisgau-Hochenschwarzwald by using green electricity from a waste-to-energy plant. In this context ILF provides technical advisory services to the client and supports with regards to permitting procedures, concept design and cost estimation. |

| Project | Service | Client | Countries | Execution Period | Purpose | Description |
|---|---|---|---|---|---|---|
| Fuel cell bus transportation study | Technological Study | GIZ | Chile | 2021 | Mobility & Transport \| Fuel Cell Vehicles \| Mining | Identification of appropriate fuel cell (FC) bus manufactures capable and willing to participate in a pilot bus project and to provide FC buses to successively replace the overall vehicle fleet. Verification of FC buses suitability to fulfil the tough requirements proper to passenger transport on the extraordinary mining route. |
| 25-50 MW hydrogen facility | Feasibility Study | confidential | Europe | 2021 | Power to gas \| Refueling Stations | A main transmission system operator (TSO) in Europe considers to feed in hydrogen in the network by adding a hydrogen producing unit (20-50 MW). A passengers vehicle and heavy duty vehicle refueling station along with a trailer filling station are also included into the study. |
| Ball valve spec. For 100% H2 | Engineering works (Specification) | confidential | Europe | 2021 | Pipelines | Ball valve specification suitable for the transport of NG as well as of pure H2 via a DN 300 pipeline of one of the leading Central European gas Transmission System Operators. |
| Hydrogen production facility for process plant | Feasibility Study | confidential | Europe | 2021 | Power to gas | The Client is a manufacturer of fuel cells and gas/diesel engines. Due to a change in company strategy, the demand for hydrogen for test benches will increase significantly in the next few years. For this purpose, a concept for hydrogen production including a hydrogen filling station at the site is to be implemented with ILF. |
| Green hydrogen certification - Production and export criteria | Consultancy | GIZ | Chile | 2021 | Production and Export | Identification of sustainability requirements of potential future green hydrogen off-takers, with special focus in the European and German market. The entire value chain of $H_2$ and its derivatives was analyzed, considering social, community and environmental aspects. They outcomes should give orientation to project developers in Chile in order to to facilitate the development of sustainable $H_2$ projects in the region. |
| H2 concept for gas engine units | Conceptual and Detailed Design | condifential | confidential | 2021 | Power to gas | Technical requirements for the operation of gas engine units with fuel mixtures up to 100% H2. ILF Services: Design planning incl. dimensioning of main components; Approval planning incl. preparation of explosion protection concepts; Coordination of construction work in coordination with the client; Preparation of explosion protection documents after implementation of measures. The following areas were implemented in the present project: Installation of an H2 supply by means of a trailer, H2 supply line from the trailer discharge to the development test stands (laid in the ground), adaptation of the development test benches for operation with hydrogen. |
| International Certification Framework - Green H2 production and export | Study | GIZ | Chile | 2021 | Production and Export | Criteria identification to produce sustainable green hydrogen and its derivatives, with its subsequent sustainable export to Europe. The study is expected to establish the framework of current certification schemes for the processes involved in the production and export of green H2 and also should provide and analysis of other (partially) transferrable certification schemes. |
| Helios Green Ammonia Production Plant | Consulting | Shearman & Sterling | Saudi Arabia | 2020 - ongoing | Ammonia production and export | NEOM is developing the USD 5 billion and 4 GW large Helios Green Fuels Project based on solar power and green hydrogen. ILF is the technical advisor to the legal representatives providing consulting for the contract development, including the offtake agreements. |
| Hydrogen Hybrid Push Boat | Conceptual Study | confidential | Germany | 2019 - ongoing | Mobility & Transport \| Ships | Design of a H2-powered pusher vessel. Includes the preparation of the documentation for IPCEI subsidies. |
| Demo4Grid Hydrogen Project | Conceptual and Detailed Design (EPCM) \| Procurement Services \| Construction Supervision | MPREIS | Austria | 2017 - 2022 | Heating \| Refueling Stations | MPREIS is partner in the "Demonstration of a 4 MW Pressurized Alkaline electrolyser for Grid Balancing Services" project funded by the EU. It includes the installation of a electrolyser unit, H2 storage tanks, a Hydrogen Refueling Station, and a H2 trailer filling/ unloading station. The electricity consumed works as a balancing service for the interconnected grid. The produced hydrogen is used for heating some MPREIS production facilities and for refueling trucks at the planned HRS. In the next phase, energy shall be supplied from a renewable source, i.e. hydropower plant in the vicinity. |
| Hydrogen readiness of gas transport network infrastructure | Due Diligence | confidential | Germany | 2021 | Pipelines \| Gas infrastructure | Red flag report and technical and environmental due diligence on the H2 readiness of a ~4,500 km gas pipeline along with seven compressor stations . Review of CAPEX and OPEX plan. Commercial and regulatory support. Work streams modelling |
| Ammonia import terminal | Study | confidential | Germany | 2021 | Waterway transport | Study on the import of green ammonia to Germany by ship in perspective to the construction of an ammonia import terminal close to a federal waterway. |
| Photovoltaic and hydrogen production plant | Feasibility Study | Gas & Power Trading | Romania | 2021 | Power to gas | Bankable feasibility study for a ~80 MWp PV power plant and a 10 MW hydrogen production plant (including storage). The excess energy provided by the PV plant will be fed into the grid. The scope also comprises the technology selection as well as the definition of the optimum PV plant design and electrolyser operation (rates and quantities). |
| Electrolyzer Availability Study | Study | confidential | Germany | 2021 | Electrolysers | One of the most known electrolyzer manufacturers comissioned ILF to conduct a RAM (Reliability, Availablity, Mantainability) study of one of its products based on data of an existing project. The goal was to verify the availability of the electrolyzer system in order to have a better basis for availability-guarantees they have to provide to future clients, and to identify potential points for improving the availability of the electrolyzer system. |

| Project | Service | Client | Countries | Execution Period | Purpose | Description |
|---|---|---|---|---|---|---|
| Algeria Solar Power Export Roadmap | Consulting | TerraSola | Algeria | 2021 | Export | Transitioning roadmap for the Algerian economy. Analysis of the key parameters for the revitalization of the Algerian economy based on competitive, local industry production, human capacity building, Algerian innovation culture, production of renewable energy and the export of green hydrogen “Made in Algeria” |
| Pipeline infrastructure data collection for refinery supply | Consulting | confidential | Europe | 2021 | Pipelines \| Refineries | Under the European Union's Renewable Energy Directive (RED) II, refineries in Europe are looking for opportunities to supply green hydrogen for their refinery processes, including blending with fuels. ILF has conducted an analysis of the European gas grid regarding the technical possibilities for feeding and transporting hydrogen on a large scale to supply European refineries. |
| Hydrogen transportation between refineries | Feasibility Study | Motor Oil | Greece | 2021 | Refineries & Petrochemical Plants | The Motor Oil Hellas (MOH) refinery in Agioi Theodoroi (Corinth) will produce significant amounts of surplus hydrogen after the commissioning of the naphtha reformer. At the same time, additional hydrogen will be needed at the refinery in Aspropyrgos. The aim of this project is to design the facilities required to enable the transport of the hydrogen excess from Corinth to Aspropyrgos. The transport options are evaluated to plan and design the compression and loading process onto H2 trailers along with the unloading process at the arrival point. |
| Import terminal for green derivatives | Feasibility Study | confidential | Europe | 2021 | Import terminals | Study on the utilization potential of an existing tank farm for the future "innovative fuels" handling. It evaluates both storage and handling of H2 carriers (e.g. ammonia, LOHC, methanol) as well as E-fuels. |
| Hydrogen production facility for refinery processes | Feasibility Study | confidential | Poland | 2020 - 2021 | Refineries | 100 MW electrolysis plant with storage tanks, fuel cells, and/or hydrogen turbines, using PV as power source. This will be the first such large-scale electrolysis installation partly supplied by its own renewable energy source. The produced hydrogen will be used primarily in refining and it will replace the currently used hydrogen produced in the steam reforming process, which significantly leads to a CO2 emission reduction. Furthermore, a 1 MW pilot plant will be designed and built. |
| Hydrogen study for Ferngas gas infrastructure | Due Diligence | First State Investments / Ferngas | Germany | 2020 - 2021 | Pipelines | First Sentier investments intended to seal its Ferngas gas infrastructure. ILF was awarded to develop a hydrogen strategy, execute a technical and environmental vendor due diligence indulging analysis of pipelines hydrogen capability and provide project management consultancy services for pipeline replacement to make them hydrogen ready. |
| Test specification for testing of H2 readiness of existing pipeline materials | Study | Confidential | Europe | 2021 - ongoing | Pipelines | The Client has surplus pipes from the pipeline construction campaign. It intends to evaluate the compatibility of these pipes for the transport of hydrogen and/or mixtures of natural gas and hydrogen. ILF shall specify the required testing scope and potential testing institutes that could carry out the tests for determining said compatibility. |
| LIFEalps: H2-Infrastructure for South Tyrol | Authority Engineering Concept Design | Institut für Innovative Technologien (IIT) | Italy | 2020 - 2021 | Refueling Stations | The LIFEalps project promotes the sustainable development of mobility in South Tyrol by fostering knowledge diffusion and investing in hydrogen infrastructure, fast charging stations, and acquisition of vehicles. In the first project phase ILF supports the design and permitting of H2 refueling stations and coordinates them with the local authorities. |
| Hydrogen Pipeline Compression Study | Conceptual Study | confidential | Germany | 2020 - 2021 | Pipelines | Detailed study of two existing compressor stations, investigating the impact of adding 2%, 5% or 10% of hydrogen into the existing gas stream. In addition, the implications for re-design into a 100% hydrogen system are investigated. |
| Hydrogen Study for High Pressure Gas Pipeline | Conceptual Study | confidential | Eastern Europe | 2020 | Pipelines | There are recent developments in Eastern Europe to generate hydrogen from renewable energy using electrolysis. The green hydrogen shall then be injected into the gas grid in percentages of 2 to 10%. ILF analyzed the permitting documentation implications in regards of technical feasibility, cost and time. A conversion to 100% hydrogen network was also considered. |
| Green Hydrogen Production and Export Study | Feasibility Study | confidential | Middle East/ North Africa | 2020 | Steel Industry \| Production & Export | In cooperation with Dii Desert Energy, a detailed feasibility study was carried on to investigate the GW scale production of green hydrogen in the MENA region and transporting this hydrogen to a major steel manufacturing plant in central Europe. ILF conducted a detailed investigation on electrolyser capacities and H2 export options, including feed into the gas network, LH2 shipping, Green Ammonia, or LOHC. |
| Element Eins: 40 - 100 MW Power-to-Gas plant | Feasibility Study | Gasunie \| TenneT \| Thyssengas | Germany | 2019 | Power to gas | Feasibility study for a 40 -100 MW Power-to-Gas project. Analysis of the wind power-based production of hydrogen and synthetic gas in order to feed it into a natural gas pipeline. The envisaged power to gas plant shall be extendible to industrial size. |
| Hydrogen Study for The Red Sea Development Project | Conceptual Study | The Red Sea Development Project Corporation | Saudi Arabia | 2019 | Energy Storage | The Red Sea Development Project is a greenfield tourism resort that is supplied with 100% renewable energy. 336 MW of total PV and wind capacity shall deliver 1.3 TWh per year. The concept study analyzed the potential to use hydrogen as the energy storage of the VRE (Variable Renewable Energy) plant, along with other end-uses e.g. for mobility purposes. |
| Wattens Hydrogen Storage System | Design Review | SES | Austria | 2018 - 2019 | Mobility& Transport \| Ships | Subject of review is the prototype developed by SES for the mobile energy storage based on methanol (hydrogen from renewable energy and CO2). |
| Extension Compressor Station Elten | Conceptual Study | OGE | Germany | 2019 | Compressor Stations | As part of the overall project of integrating a new compressor into the existing facility, ILF investigated the implications of feeding hydrogen into the existing natural gas system at different volume ratios. The concept design focused on machinery, balance of plant, as well as the analysis of the implications on authority approvals and costs. |