

CAPABILITY STATEMENT HYDROGEN PRODUCTION, STORAGE AND TRANSPORT

2020

XX0217-ILF-OD-00021 | Revision 01.1 © ILF



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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's main business areas are:

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



“ILF combines local presence and international expertise to best serve clients’ needs.”

Klaus Lässer, CEO



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 CO₂ 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.

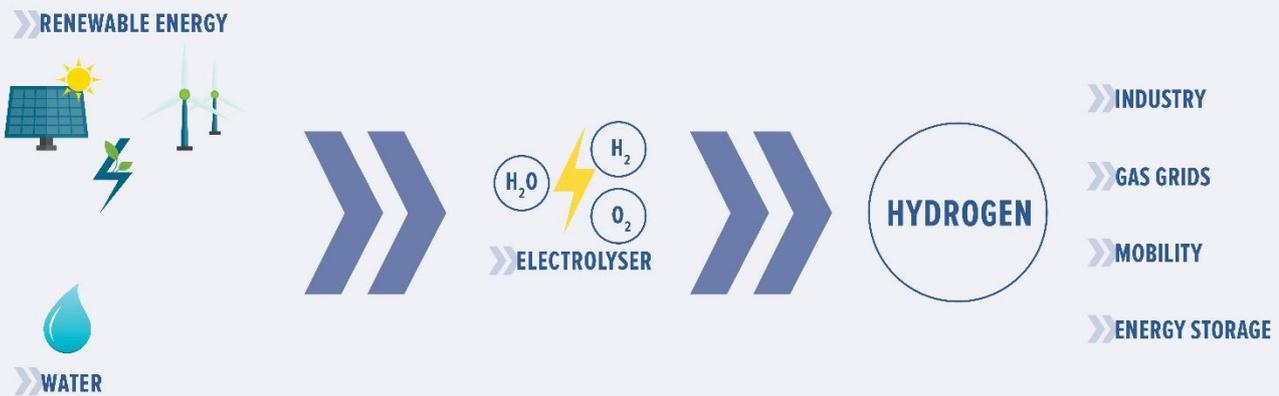
PROJECT HIGHLIGHTS

- **DEMO4GRID**, Owner's Engineer performing concept design, permitting, as well as detailed design for MPREIS Austria for a 4 MW Electrolyser facility, H₂ storage facilities, as well as an H₂ refuelling station
- **ELEMENT EINS**, Feasibility Study for Gasunie/ TenneT/ Thyssengas, Germany for a 40 MW – 100 MW Power-to-Gas facility including electrolyser plant, Methanation, H₂ pipeline, as well as H₂ injection into the existing gas network
- **RED SEA DEVELOPMENT PROJECT**, Feasibility Study for the Red Sea Development Company investigating hydrogen as a potential energy storage solution for up to 50 MW of excess power from renewable generation sources.

- **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 H₂ 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 H₂ 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

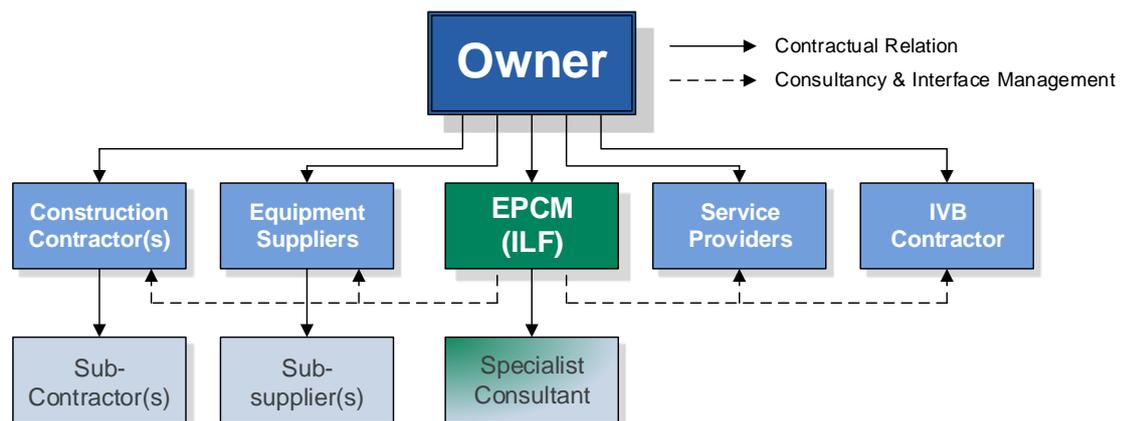
- **Conceptual Engineering** including **Feasibility Studies** and **Concept Design** with system and technology option selection assessments including techno-economic risk analysis, preliminary facilities site and pipeline routing studies.
- **Basic Engineering / pre-FEED** to define the main process engineering activities and further detail the selected system and key technologies/equipment for H₂ 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 all other 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.

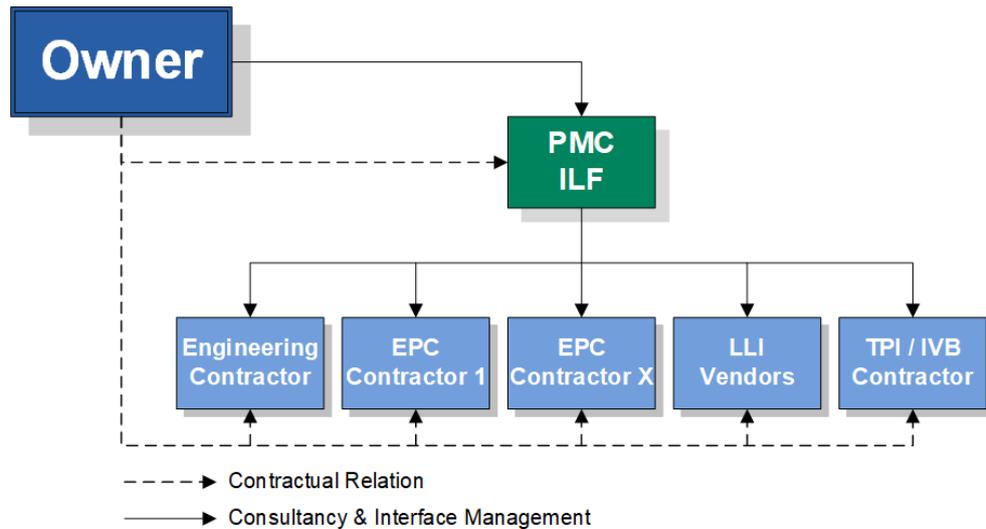
- **Procurement Support** to supplement the client's procurement and contracts management teams with additional resources and competencies by taking over the entire procurement management or of selected individual packages.
- **Construction, Commissioning & Start-up Supervision** to organize and coordinate 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 & FINANCIERS

- 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.



Hydrogen Hybrid Pusher Tug

The aim is to develop a hydrogen hybrid pusher tug for the port of Hamburg. In a first step the concept for the boat and the land infrastructure will be further elaborated, followed by detailed planning, approval and finally implementation with the construction of the pusher boat in line with market conditions.

Main services: Conceptual Study



HP Gas Pipeline

Aim of the project is to analyze to what degree modifications of the medium are influencing the capability of the designed pipeline system, in order to admix hydrogen to the gas grid and transport it in the existing gas pipeline networks.

Main services: Conceptual Study



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

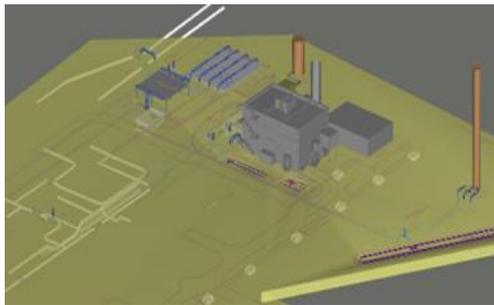




Hydrogen Study for The Red Sea Development Project

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 to the consumers. The concept study shall analyse the potential to use hydrogen as energy storage but also for supplying consumers, e.g. for mobility purposes.

Main services: Conceptual Study



Extension Compressor Station Elten

As part of the overall project of integrating a new compressor into the existing facility, ILF have 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

