



FICHTNER

Hydrogen Portfolio

Working Areas and Project Examples



Established in 1922 and family-owned ever since



Project experience in more than 170 countries



Total turnover of €217 million in 2019



1500 employees worldwide – over 500 of these in our home office



Long-standing employees from 66 nations



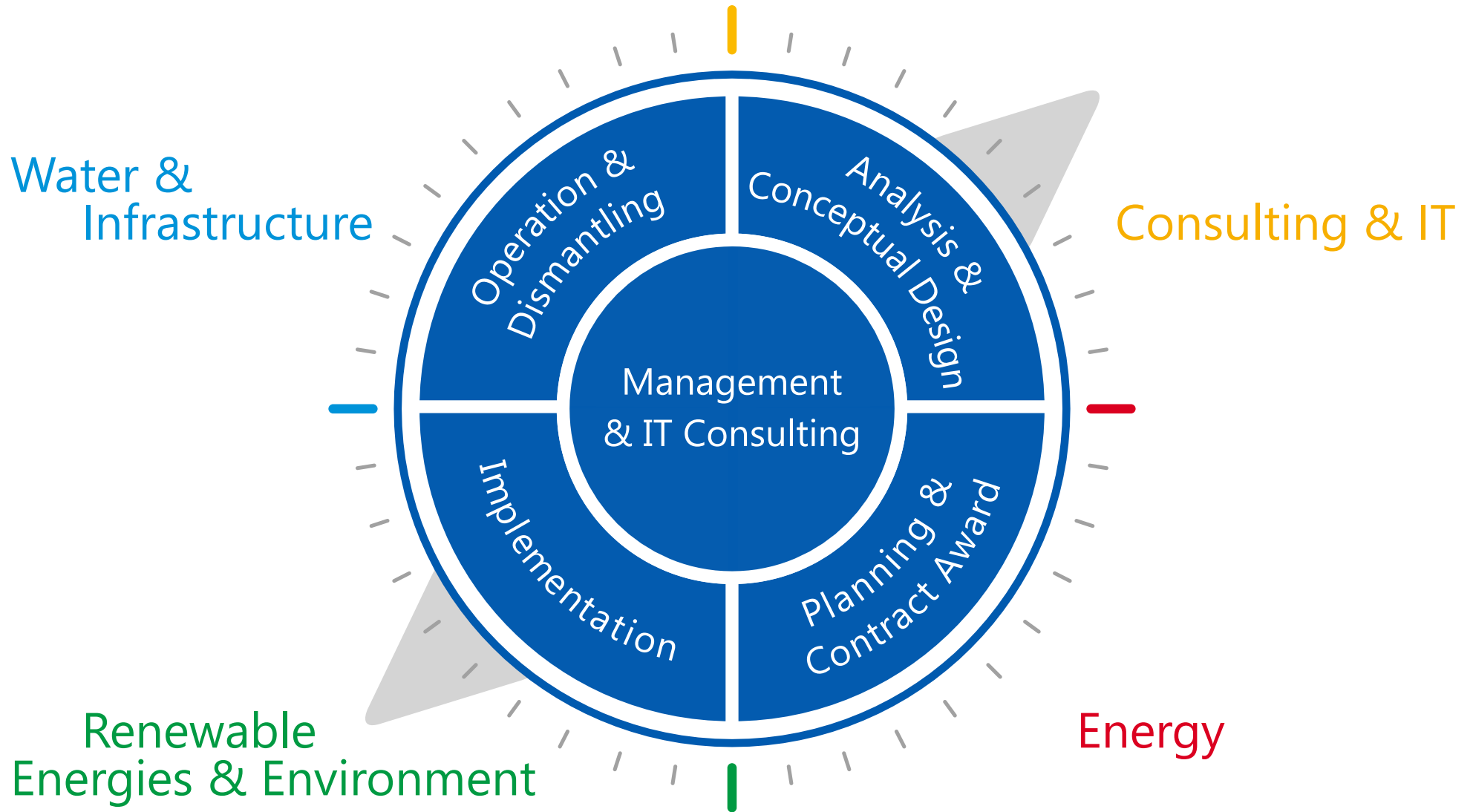
Certified systems for quality, workplace health, safety, compliance, environmental protection

130+ locations

60 countries

61% export share

Home office in Stuttgart | Present in 60 countries worldwide
Represented at over 130 locations by subsidiaries and affiliates, branches and project offices
61% of Group revenues generated outside of Germany



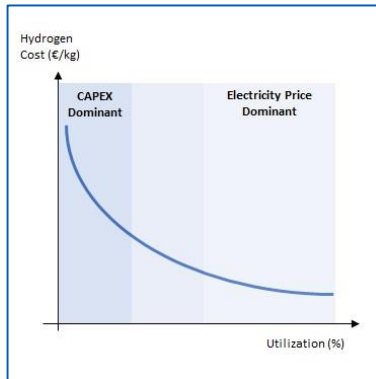
Planning and consulting in all project phases -
for technically and economically sound solutions

Fichtner is working in all areas of the hydrogen value chain and is actively contributing to the sector's development

Fichtner competencies



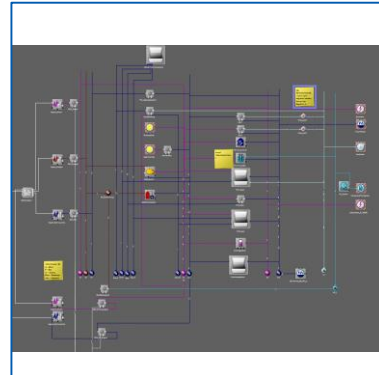
Business Models



Hydrogen business model development e.g. for a company in the natural gas industry



System Planning



System modelling to integrate power-to-x technologies (from plant to country level)



Hydrogen Plant Design



Three decades engineering experience for installations with hydrogen



Hydrogen Infrastructure



Hydrogen-readiness of natural gas assets and grid calculation of networks



Hydrogen Mobility



Integrated concepts for hydrogen production and mobility infrastructure



Carbon Capture



Experience as owner's engineer for FEED studies for new and existing plants



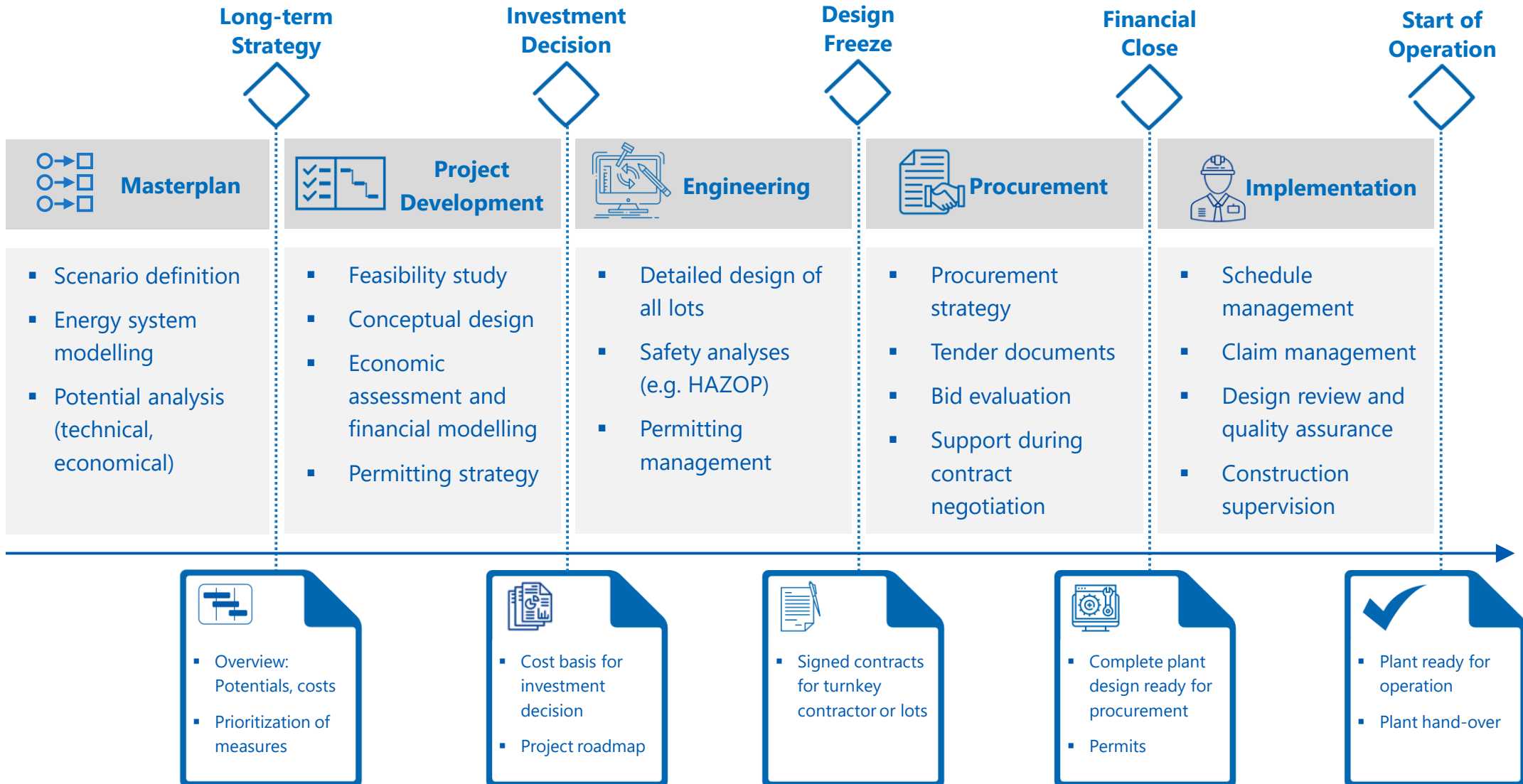
Sector Development



Fichtner Forum Hydrogen 2019 with over 60 participants from 16 countries

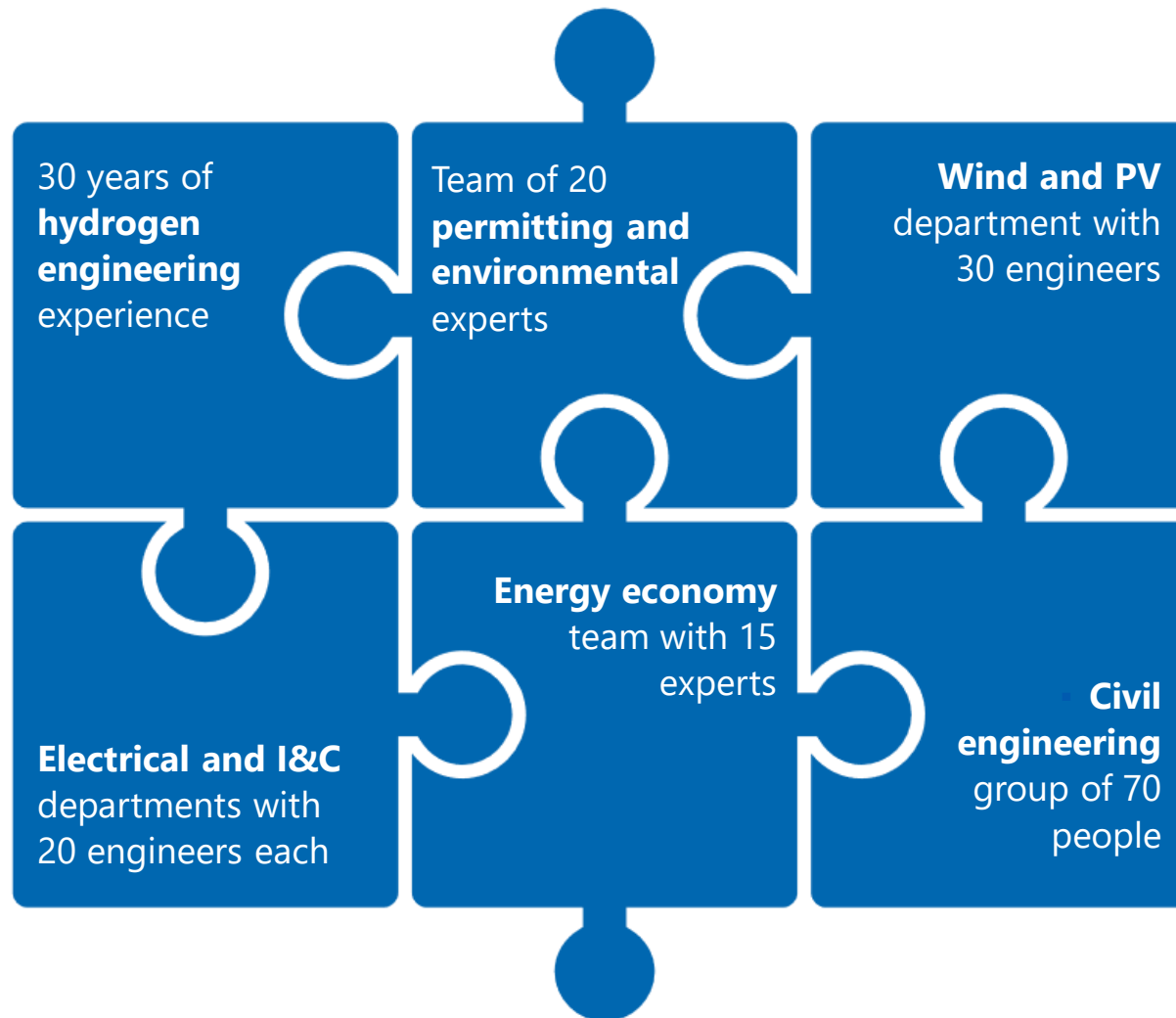
Fichtner is able to support a project throughout its entire lifecycle, from the first idea up to the start of operation

Fichtner services



Experienced experts in all areas of hydrogen projects are working at Fichtner.
This allows us to deliver complete projects from a single source

Fichtner's capabilities



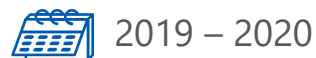
Policy Consulting- Project Example

Support for the Development of a National Hydrogen Strategy

As part of this project, Fichtner assisted Chile's Ministry of Energy in the development of its national hydrogen framework. This involved an analysis of the normative and regulatory framework for the entire hydrogen value chain both internationally as well as in leading countries. Based on the information obtained and processed, Fichtner provided the Ministry with a basis for developing its own regulatory framework so as to optimally exploit hydrogen's potential in its country.

Fichtner's services

- Development of a detailed chart showing hydrogen value chains
- Identification and analysis of international technical standards for all stages of the value chain
- Identification of regulations and policies for hydrogen value chains in various countries
- Comparative analysis of hydrogen market regulation and legislation in leading countries
- Assessment of the international regulatory framework for segments of the value chain



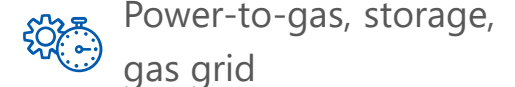
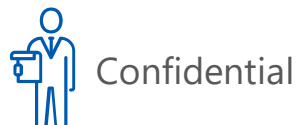
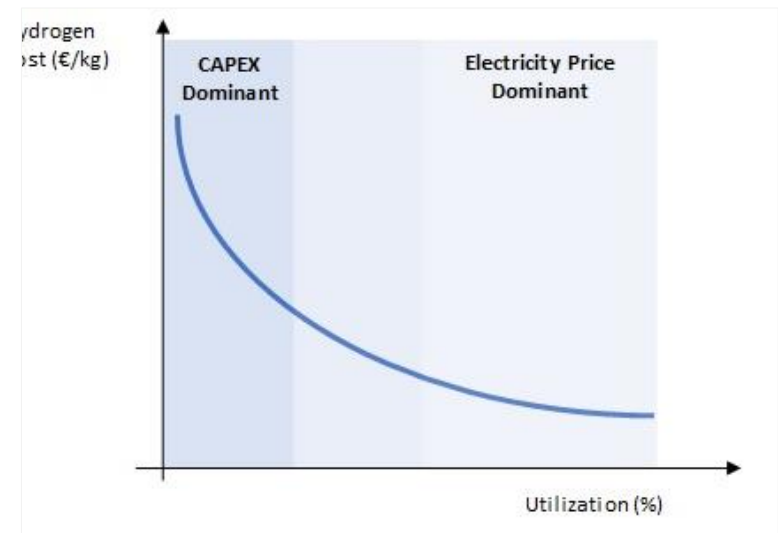
Business Models - Project Example

Feasibility study: hydrogen-based energy storage in the gas network

As an option for the chemical storage of energy, hydrogen is assigned a central role in the energy systems of the future. Against this background, Fichtner develops a concept study for a hydrogen-based energy storage system. Under the technical section of the contract, the system is planned and its operational characteristics defined. The economic/commercial section prescribes analyses of potential business models of such a system and identifies the constraints under which they should be followed up.

Fichtner's services

- Review of technologies
- Review of the energy market
- Investigation of regulatory frameworks
- Layouts of plant concepts
- Economic analysis
- Appraisal of potential business cases



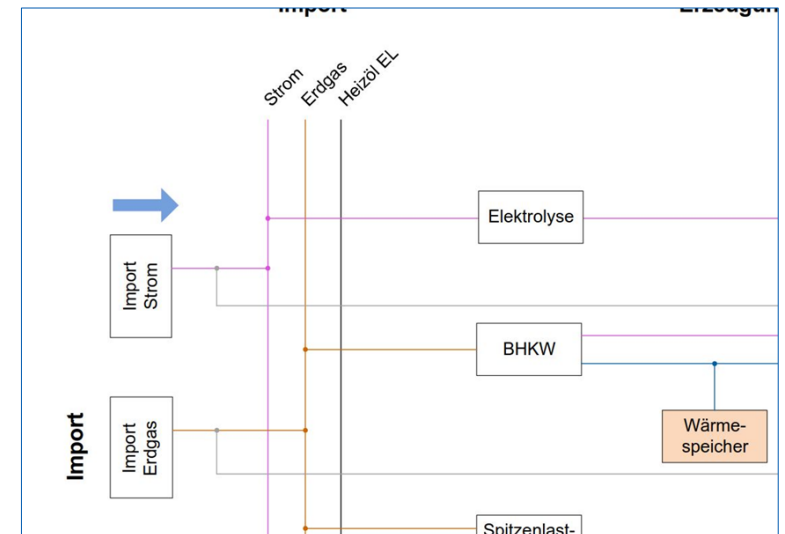
System Planning - Project Example

Modeling the energy supply based on 100% renewables and integrated energy

In order to significantly raise the share of renewable energies in energy supply systems in a German federal state by 2040, Fichtner investigated options for intensifying the exploitation of green power in other sectors through power-to-X technologies. These comprised, for example, power-to-gas, power-to-heat, power-to-e-mobility and power-to-H₂-mobility. For this investigation, an energy system model was set up for the year 2040 for the federal state under consideration. The result showed how, and by means of which power-to-X technologies, added value can be generated in diverse sectors.

Fichtner's services

- Energy system modeling
- Investigation of a range of power-to-X technologies
- Analysis of potential



Thega Thüringer Energie- und GreenTech-
Agentur GmbH



2016 – 2017



Power-to-X
technologies; energy
system model

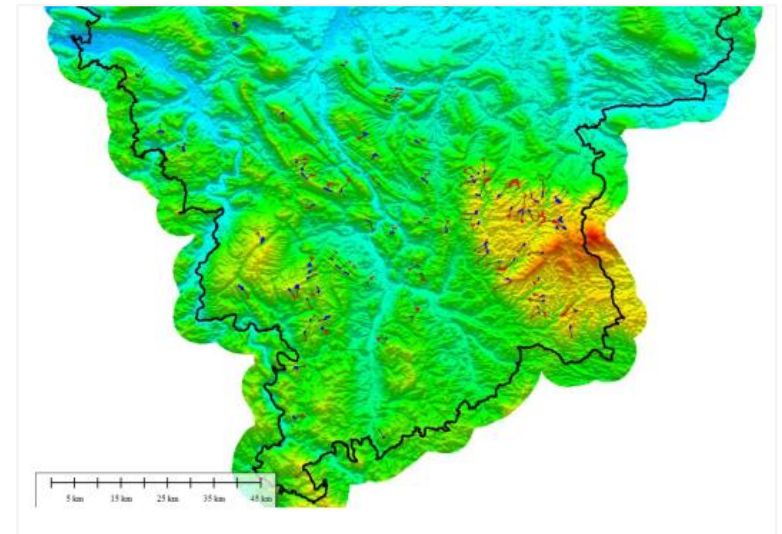
System Planning - Project Example

Development of concept for energy storage in Lower Saxony until 2030

As part of the preparation of the "Energy Storage Development Concept in Lower Saxony", technologies are investigated that have the potential to store energy both mechanically and chemically on a grid scale. Included among these is hydrogen storage. Activities include presentations of the principles of operation, analysis of potential, and feasibility studies. On the basis of the assessments of their potentials and the feasibility studies, the technologies were prioritized and compared in terms of their cost-effectiveness.

Fichtner's services

- Depiction of the principles of operation of various energy storage technologies, e.g. hydrogen storage
- Analysis of potential with regard to storage capacity and power output in relation to the time required for energy input
- Feasibility studies in terms of the configurations and modes of operation of the storage systems
- Listing the energy storage technologies in order of priority
- Comparison of the technologies' economic performance



Innovationszentrum Niedersachsen Strategie
und Ansiedlung GmbH



2013 – 2014



Energy storage

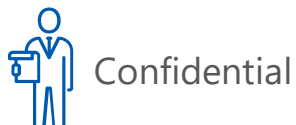
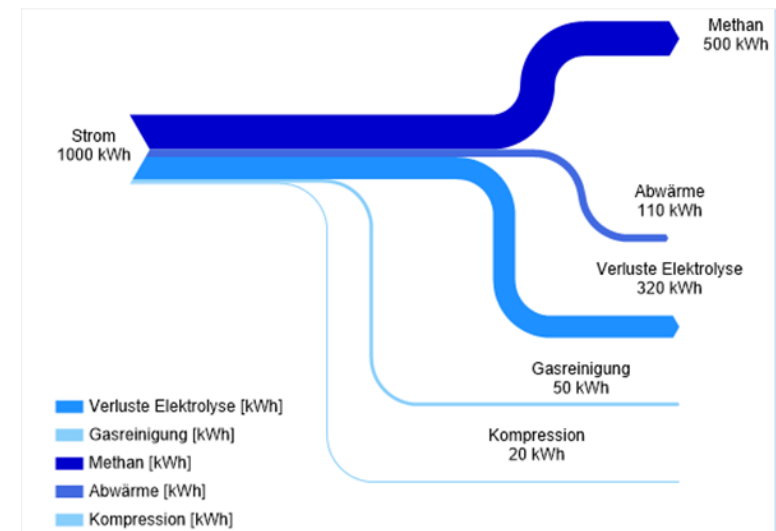
Hydrogen Plant Design - Project Example

Feasibility study of power-to-X at a power plant site

As a result of the transition to renewable energies, the capacity utilization of conventional generation plants is being reduced. However, due to existing infrastructure, grid connections and social acceptance, their locations are of great value for future energy systems. Their continuous development to cater for new technologies is thus a logical course of action. For this project, Fichtner developed integrated energy options for an existing power plant site.

Fichtner's services

- Devising plant concepts for electrolysis, methanization and synthetic fuels
- Evaluation of options under technical aspects
- Investigation of tie-in at the site and to the gas network
- CAPEX and OPEX estimates
- Regulatory framework
- Repercussions for safety at the site



Confidential



2019



Power-to-X; H₂ in the natural gas grid

Hydrogen Plant Design - Project Example

Conceptual planning for hydrogen production with operation of a hydrogen filling station

A proof-of-concept project for integrated energy is to be realized at an existing power plant site. As an energy hub, this location offers great potential for integrating the electricity, mobility and gas sectors. Fichtner drew up a generation, offtake and infrastructure concept that matched energy supply to demand. This provided the basis for planning the electrolysis plant and the hydrogen filling station.

Fichtner's services

- Identification of potential customers and development of supply scenarios
- Conceptual design of the electrolysis plant and the hydrogen filling station
- Economic evaluation of the developed concepts
- Possibilities for financial backing
- Plant configuration planning



Stadtwerke Leipzig GmbH (municipal utility)



2019



Power-to-gas, mobility

Hydrogen Plant Design - Project Example

Feasibility study for wind-powered hydrogen, electricity and heat supply

The project aimed at demonstrating the entire process chain for hydrogen production and use, considering the following key points: wind energy exploitation as basis; hydrogen generation, treatment and storage; its utilization in the vicinity, e.g. hydrogen filling station, fuels for rocket engine shop testing; and firing hydrogen for power generation with utilization of heat. The required electricity is to be provided by local wind power generation. Fichtner conducted a feasibility study for this purpose.

Fichtner's services

- Outline technical concept
- Examination of options
- Economic analyses



German Aerospace Center (DLR), Hardthausen,
Germany



2013



Technical concept;
economic viability

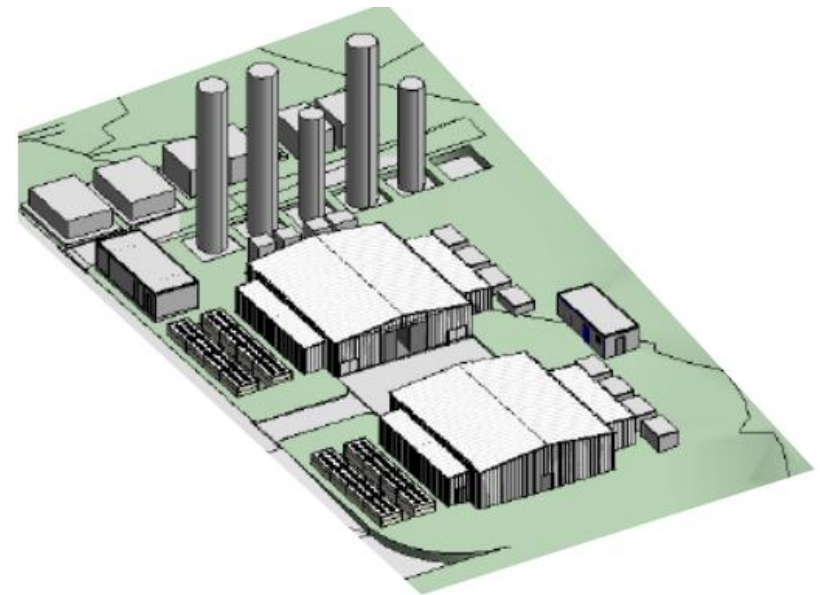
Hydrogen Plant Design - Project Example

Planning services for distributed electrolysis solution in Wunsiedel

Siemens AG plans to build a hydrogen production plant at the Wunsiedel site in cooperation with local project partners (SWW Wunsiedel, Riessner Gase GmbH). The plant represents a lighthouse project for a holistically implemented energy transition. Surplus energy available in the region is to be used to produce hydrogen and make it available for various applications. In the first stage of development, a Siemens PEM electrolyzer with an electrical connected load of 5 MW and an output of up to 500 t/a is to be built. The project is thus one of the largest electrolysis plants in Germany to date.

Fichtner's services

- Planning services under service phases 1 to 8 of the HOAI (German Official Scale of Fees for Services by Architects and Engineers)



Siemens



2020



Power-to-X, detail engineering

Hydrogen Plant Design - Project Example

Construction of new upper stage testbed for the Ariane 6 rocket

At DLR's Lampoldshausen site, fueling and firing tests are to be conducted with the Ariane 6's future upper stage. For this purpose, the new P5.2 testbed was constructed. The installation consists of supply systems for cryogenic media (hydrogen and oxygen) plus gas systems. The testbed is to be tied into the existing infrastructure. Fichtner supervised this project over its entire lifecycle, including installation, broken down into contract lots, of the testbed and its supply facilities, project execution, and construction supervision.

Fichtner's services

- Feasibility study and design of testbed concept
- Safety analysis
- Support during detail engineering
- Project control
- Procurement planning
- Supervision of technical execution
- Interface management and expediting
- Site management



Photo: German Aerospace Center



German Aerospace Center (DLR), Hardthausen,
Germany



10/2010 – 09/2018



> 20 supervised
contract lots

Hydrogen Plant Design - Project Example

Construction of new P8.3 rocket engine testbed

At DLR's Lampoldshausen site, the new P8.3 testbed is to be constructed for R&D purposes. This installation consists of supply systems for cryogenic media (hydrogen, oxygen and LNG) as well as for ethanol plus gas pipework for H₂, O₂, N₂ and He. The testbed is to be integrated into the existing infrastructure. As general planner, Fichtner supervises this project over its entire lifecycle, including detailed planning for construction and plant engineering, production engineering for cryogenic piping systems, procurement in lots of construction and plant engineering, project execution, and construction supervision.

Fichtner's services

- Feasibility study and safety analysis
- Planning of permit applications with general planning for construction and plant engineering as well as project control
- Planning production engineering for cryogenic pipelines
- Specification and procurement in 22 contract lots
- Monitoring of technical execution with interface management and expediting
- Acting as site engineer



Photo: German Aerospace Center



German Aerospace Center (DLR), Hardthausen,
Germany



2016 – 2020



General planning
services – detail
engineering

Hydrogen Infrastructure - Project Example

Conceptual Design of a 100% Hydrogen-Ready Natural Gas Infrastructure

The client is developing the natural gas connection (1,25 GW) for a combined cycle power plant and district heating boiler system. In order to be suitable for a low-carbon future, the installation shall be designed under the assumption to allow a switch from natural gas to 100% hydrogen with minimum effort. Thus, 100% hydrogen operation is already considered in today's design. The system engineered by Fichtner consists of gas pressure control and measuring systems, pipelines buffer storages.

Fichtner's services

- Process equipment
- Instrumentation and control
- Electrical systems
- Civil
- Permitting engineering



Germany, client confidential



2020



Hydrogen
infrastructure



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