Hydrogen Site Lampoldshausen – On-site Production of Green Hydrogen and Technology Transfer from Space Applications

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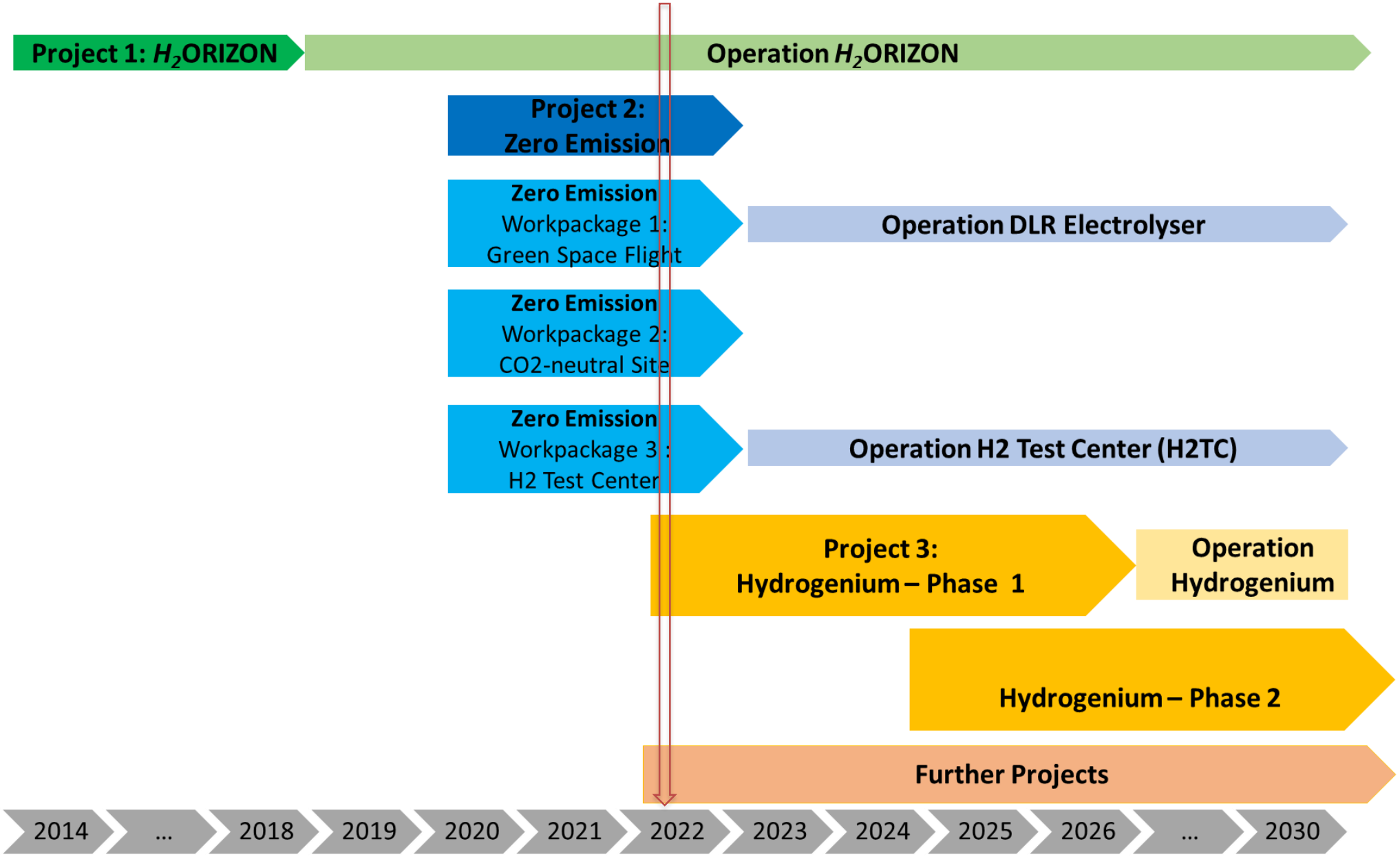
Department Applied Hydrogen Technologies (AWT)

DLR

Outline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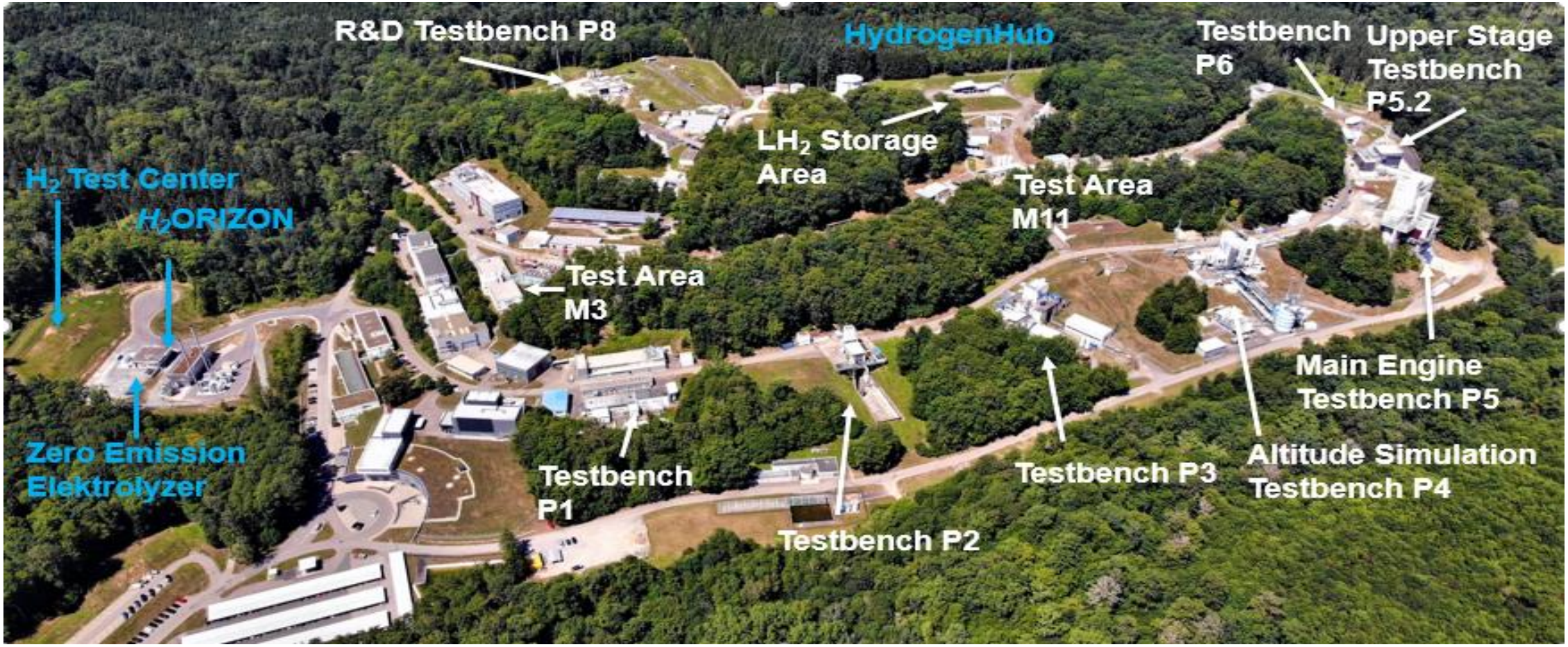
DLR Site Lampoldshausen



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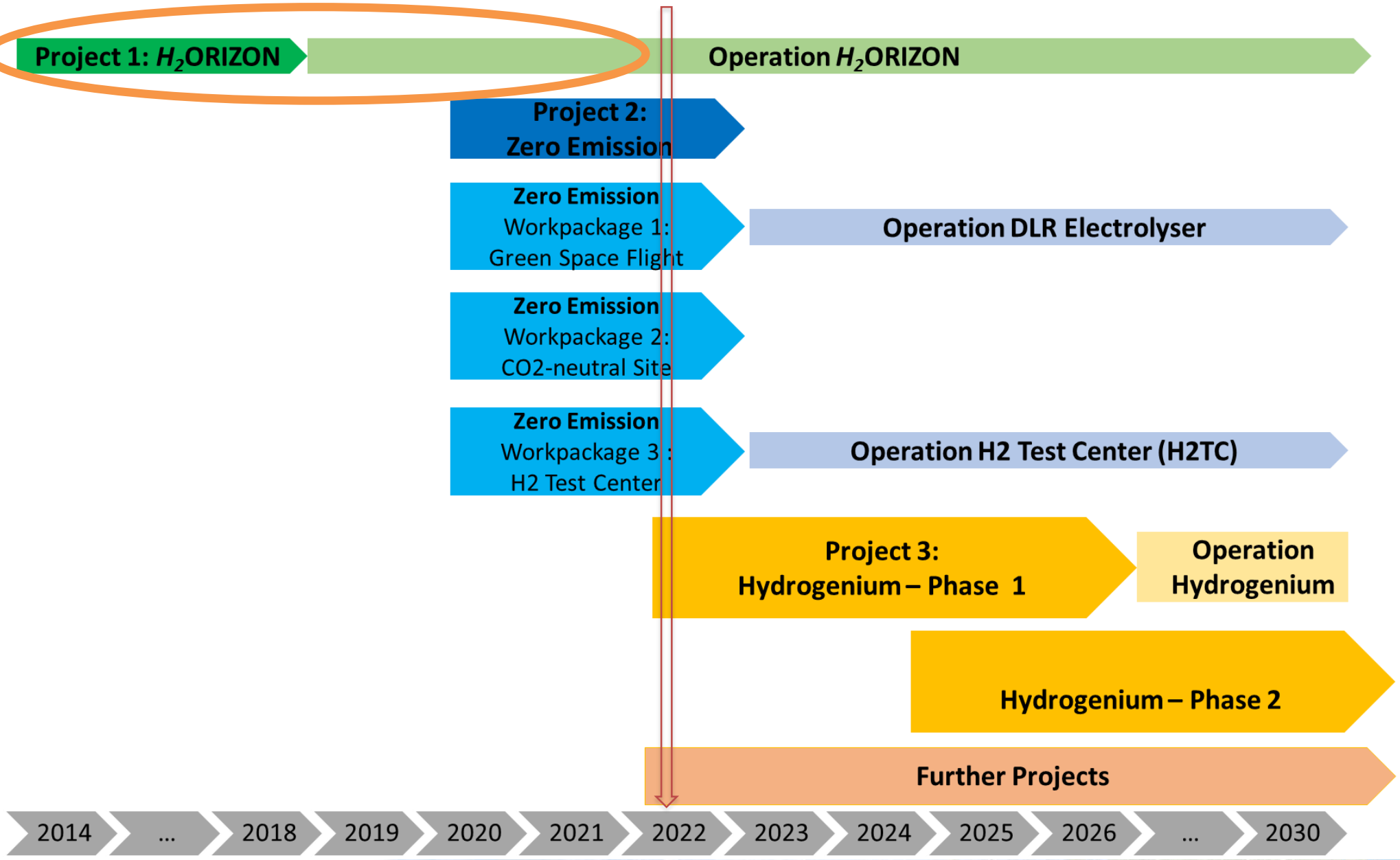
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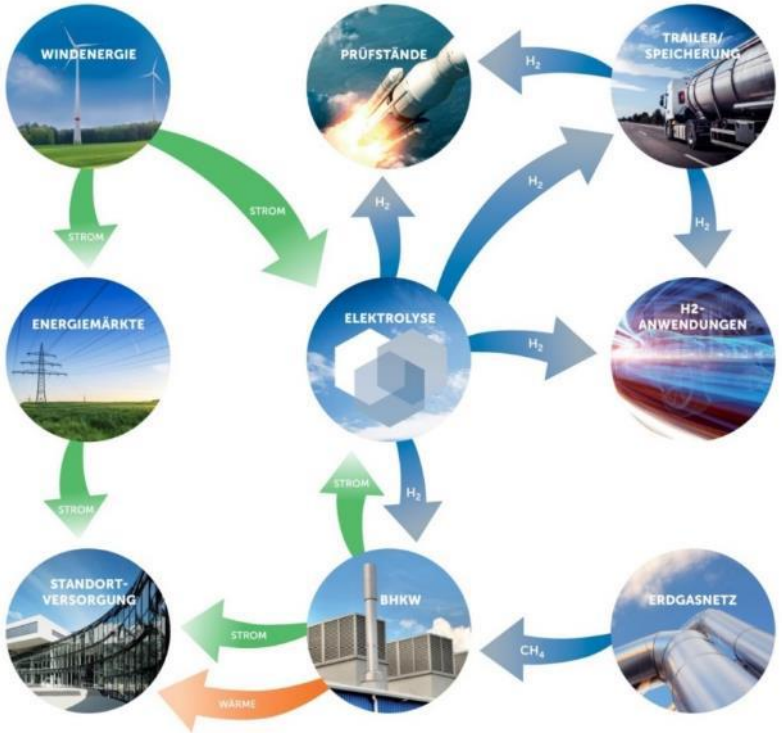
H_2ORIZON: Research- and Demonstration Platform



Fact sheet

Project start 2015

~ 900.000 Euro funding Ministry for the Environment, Climate and Energy Management

Project Partner ZEAG Energie AG

PEM Electrolyzer as **Research platform**

Hydrogen production via wind power

Usage of hydrogen for rocket engine tests and in H_2 test center

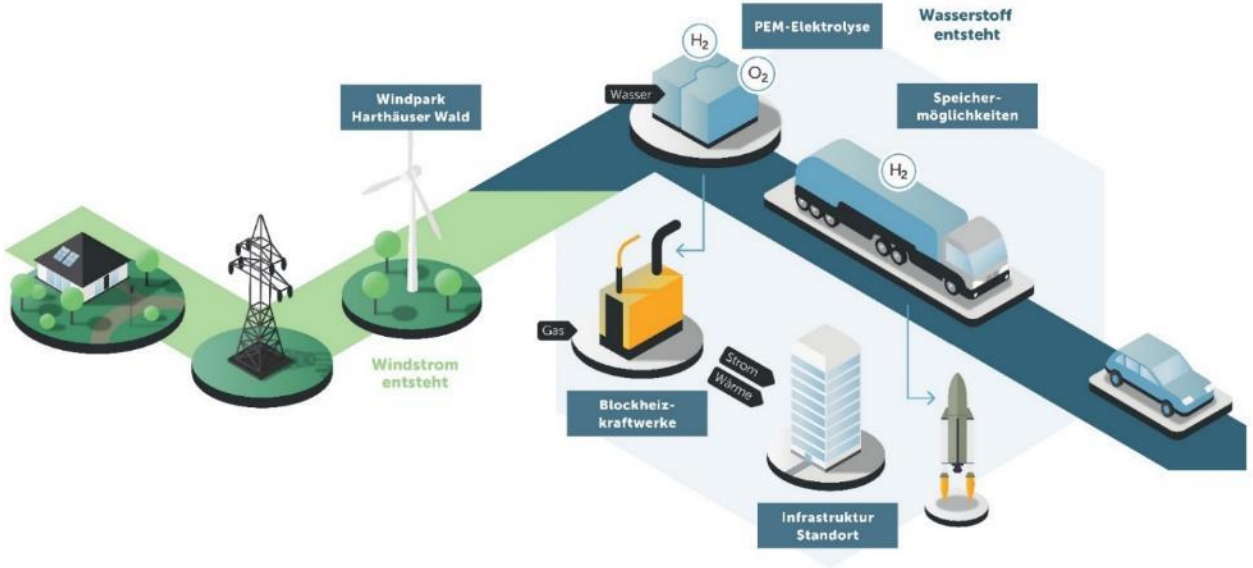
Power & heat generation via BTTP with methane hydrogen mixture

Start of normal operation 03/2022

- ✓Usage of existing **Infrastructure** *(54MW wind park & DLR test facilities)*
- ✓combining of **Competences** *(Research, hydrogen & energy economy)*
- ✓**Sector coupling** for an optimized operation (*space flight, energy economy & Traffic)*

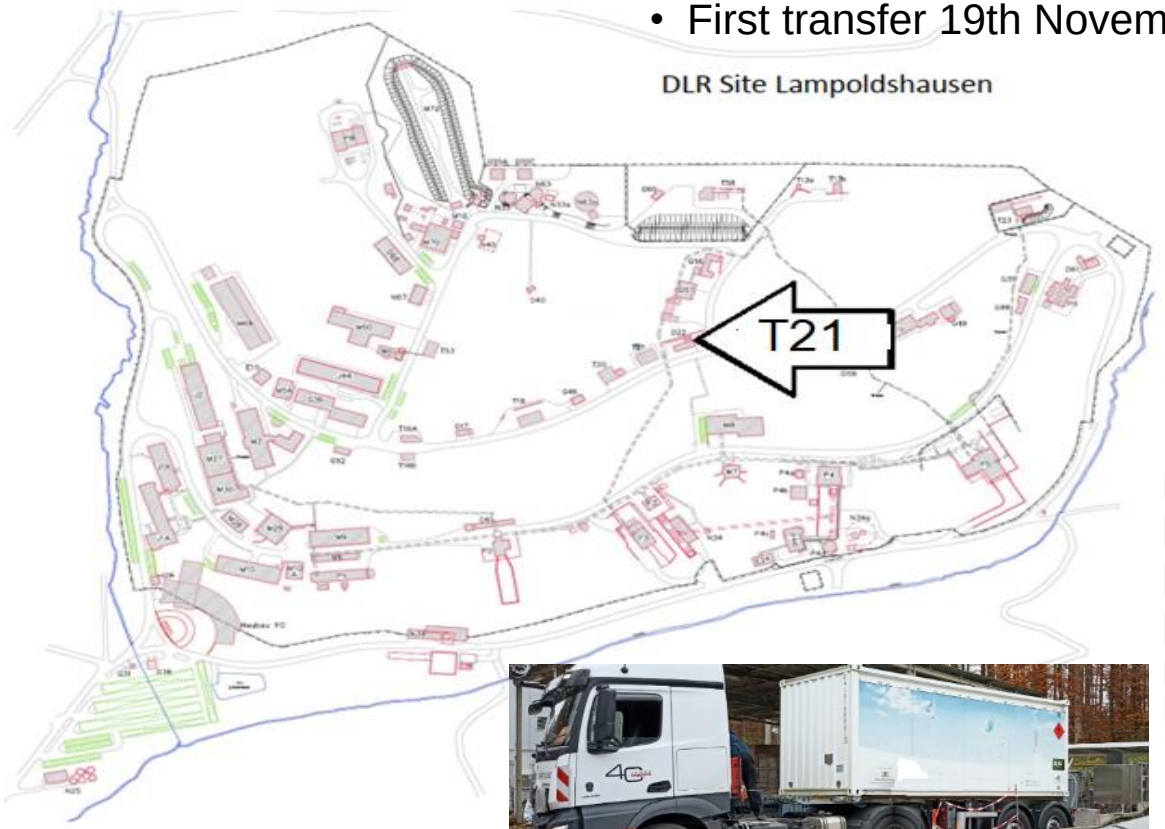
H_2ORIZON at a Glance

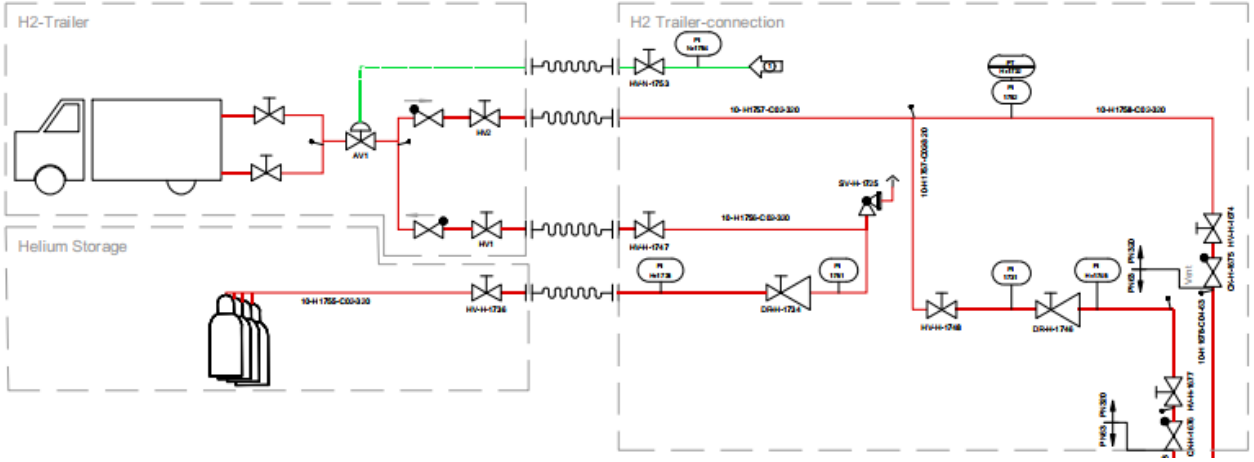
- PEM electrolyzer (880 kW electrical power, max. 14,1 kg/h GH2)
- 100 % green hydrogen from wind energy
- Compression auf 300 bar
- Tube trailer as buffer storage (about 300 kg @ 300 bar)
- Combine heat and power plant with gas motor peak power 1,7 MW (thermal) und 1,4 MW (electric)



GH2 Transfer

- Hardware status unloading panel at T21
  - ZEAG trailer
  - First transfer 19th November 2021





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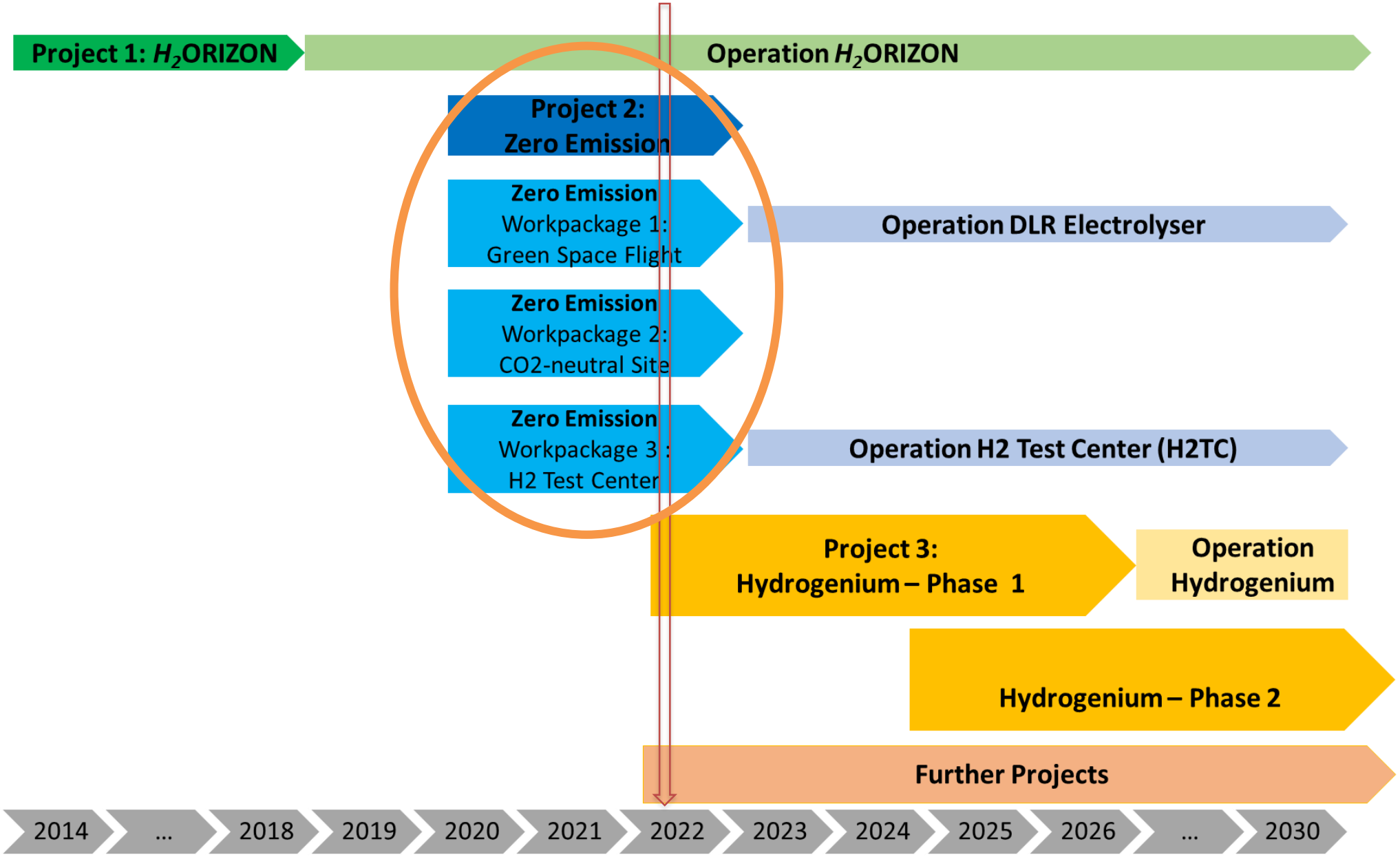
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Project: Zero Emission

Green Space Flight

CO2 – neutral Site

H2 Test Center

Enhance production of green hydrogen with 2nd PEM electrolyzer (about **3 MW – 300 t/year**)

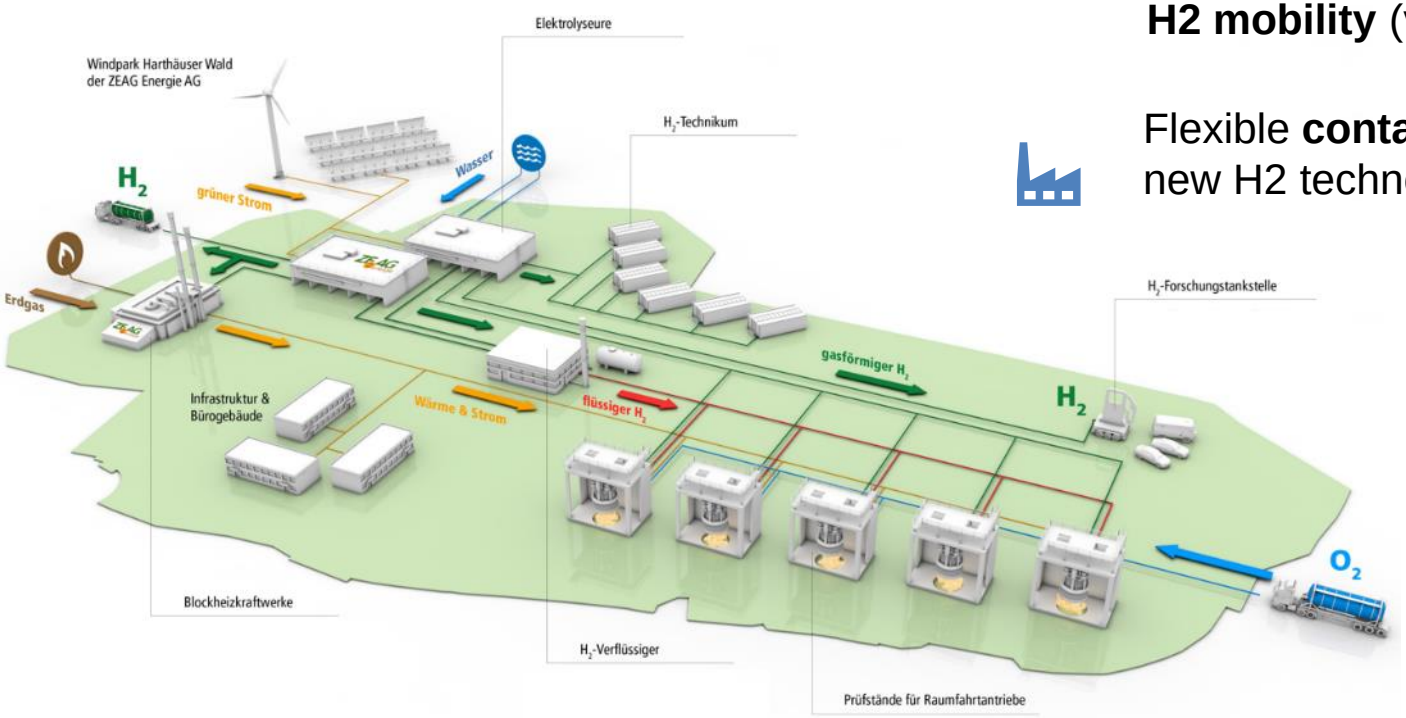
Extension of H2 infrastructure (storage & distribution system)

On-site production of LH2 with **liquefier**

Assessment and optimization of **site energy system**

H2 mobility (vehicles & fueling station)

Flexible **container based test center** to support development of new H2 technologies in cooperation with industry and science



Realization framework

Project duration: 05/2020 to 12/2023

~16 Million € Funding
Ministry of Economics, Labor and Housing Baden-Württemberg

Zero Emission – Green space flight

Erection of an additional electrolyzer

- Increase of H_2 generation capacities
- Construction of a pipeline to connect the electrolyzers and the H_2 test center to each other and to the on-site media supply for the test bench facilities

Erection of a liquefier

- Additional supply of approximately 140 tons of liquid hydrogen per year

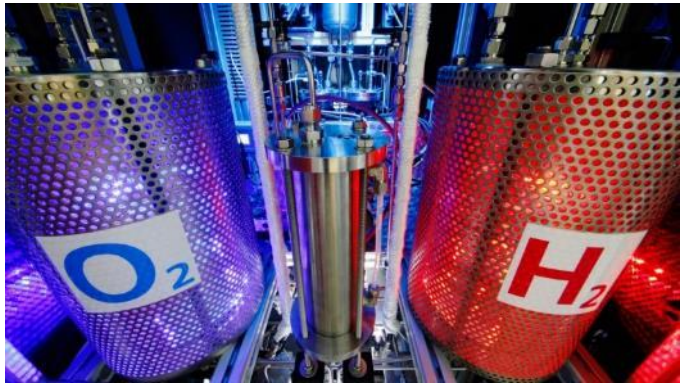


Foto: DLR / Thomas Ernsting

Electrolysis capacities

ZEAG Energie AG: 0,9 MW

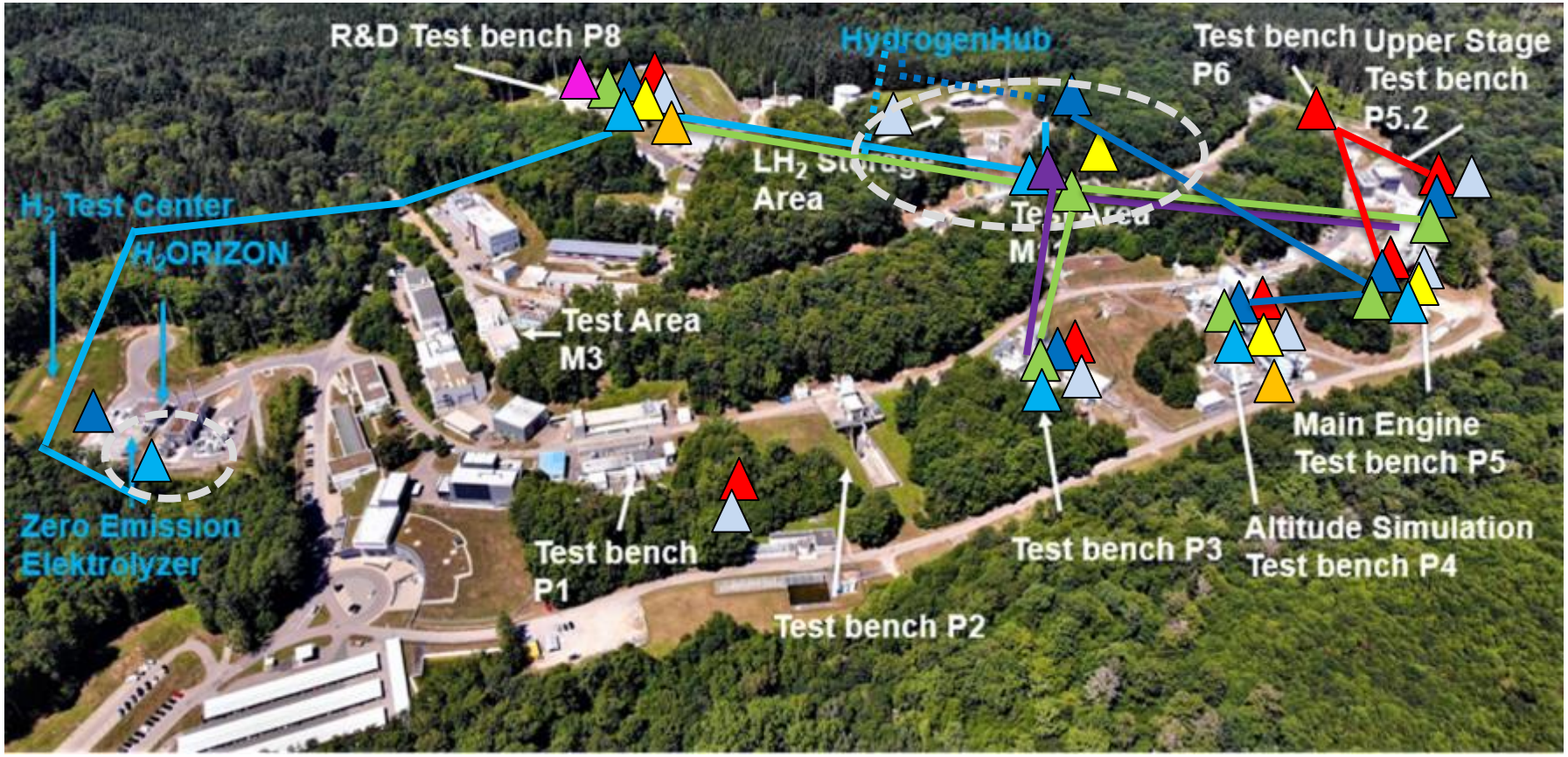
100 tons of H_2 per year

DLR: 2 MW

180 tons of H_2 per year

Main media supply systems

	Piping	Tank
GH_2		
LH_2		
GN_2		
LN_2		
GOx		
LOx		
CH_4		
GHe		
Water		



Production and/or Refilling area

Zero Emission – CO_2-neutral site

Expansion of the site's energy supply system based on a sustainable design

- Design of an ideal energy system (generation, storage, sector coupling).
- Design of the new energy system, development and implementation of an optimal operation management with machine learning methods

Reduction of emissions in mobility

- (Procurement and operation of a mobile H_2 filling station)
- Expansion of the vehicle fleet with fuel cell vehicles
- Clarification of research questions on H_2 mobility

Fuel Cell car Toyota Mirai II

Project partner

DLR Institute of Networked Energy Systems

DLR Institute of Vehicle Concepts

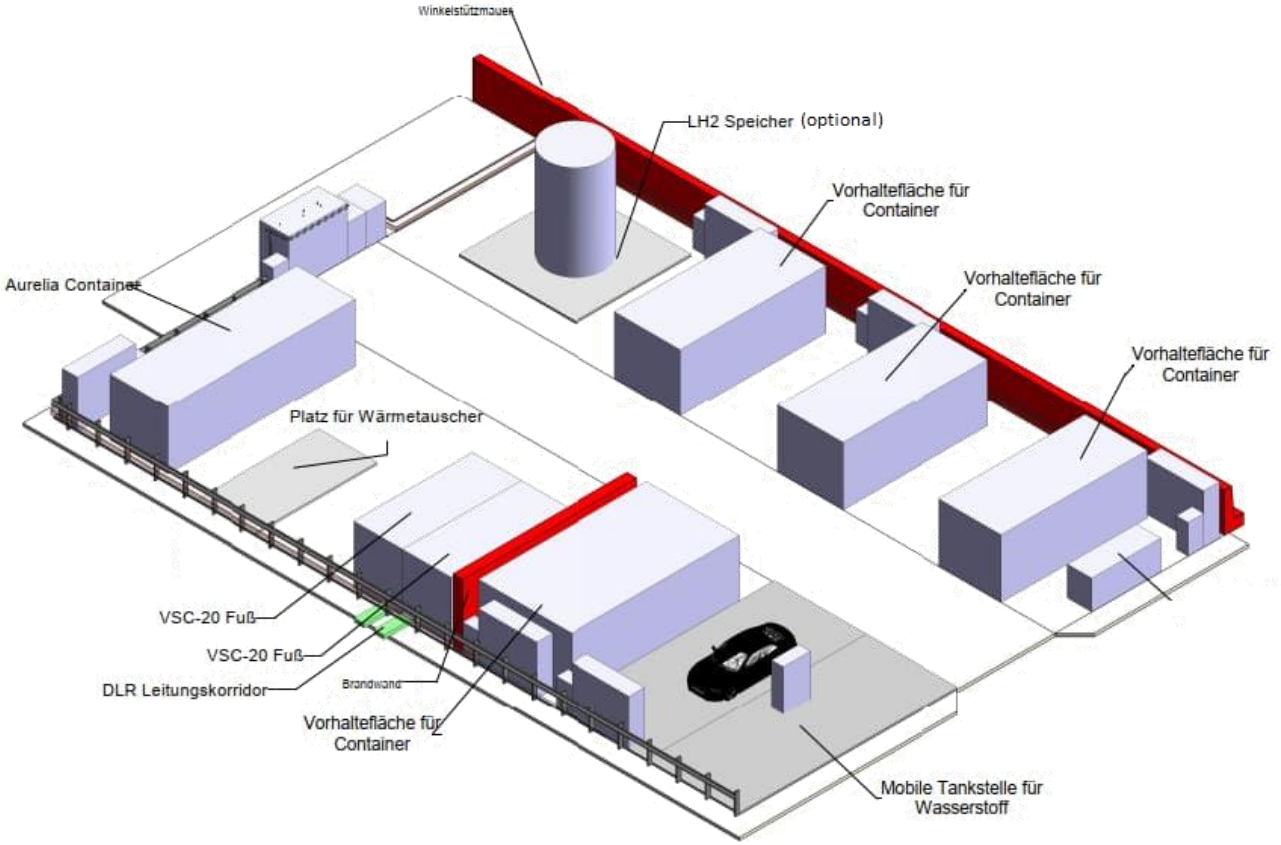
DLR Institute of Space Propulsion

H2CT - Container-based Hydrogen Test Center

- Hydrogen test center with 7 test positions, centralized media and safety infrastructure, 24/7 operation
- Start of operation Q2 2023

Main supplies:

- Green GH2 from own electrolyzer
  - 30bar (for 24/7 operation)
  - 300bar (not for 24/7 operation)
  - Max. 60kg/h
- Liquid H2 supply as growth potential (one test position blocked)
- Nitrogen 300bar (purge & valve control)
- Power up to 500kW
- Use water
- Ultra-pure water



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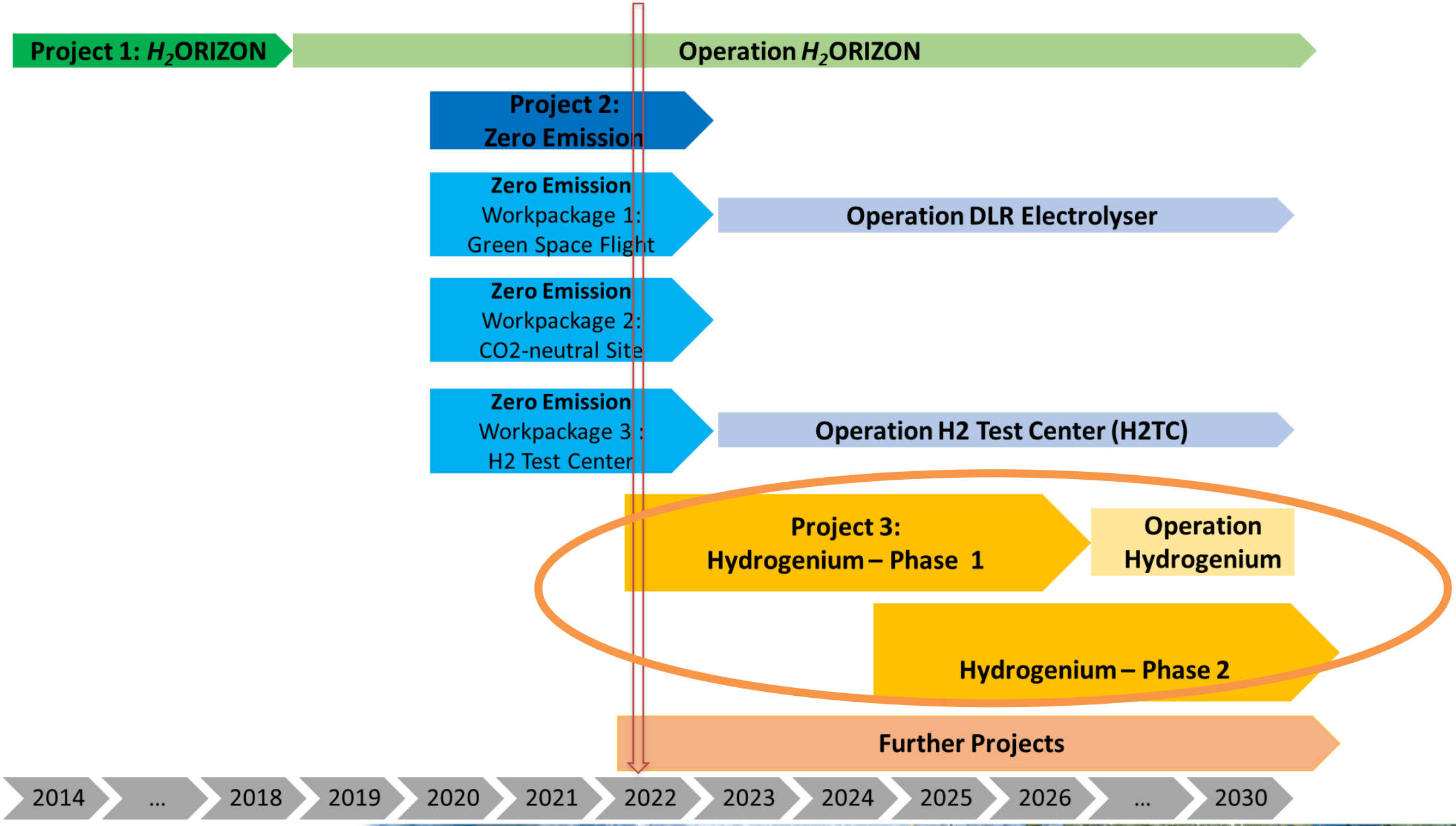
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Hydrogenium

Expansion of a permanent test, application and transfer center on an industrial scale for medium-sized companies:

- Development and testing of hydrogen components and systems
- Innovative solutions from idea generation to market maturity of systems and components
- Various studies by partners, such as a diffusion study in the Heilbronn-Franken region
- Test infrastructure focusses: high mass flows and liquid hydrogen

Realization framework

Project duration: 07/2022 to 12/2026

~12 Million € Funding

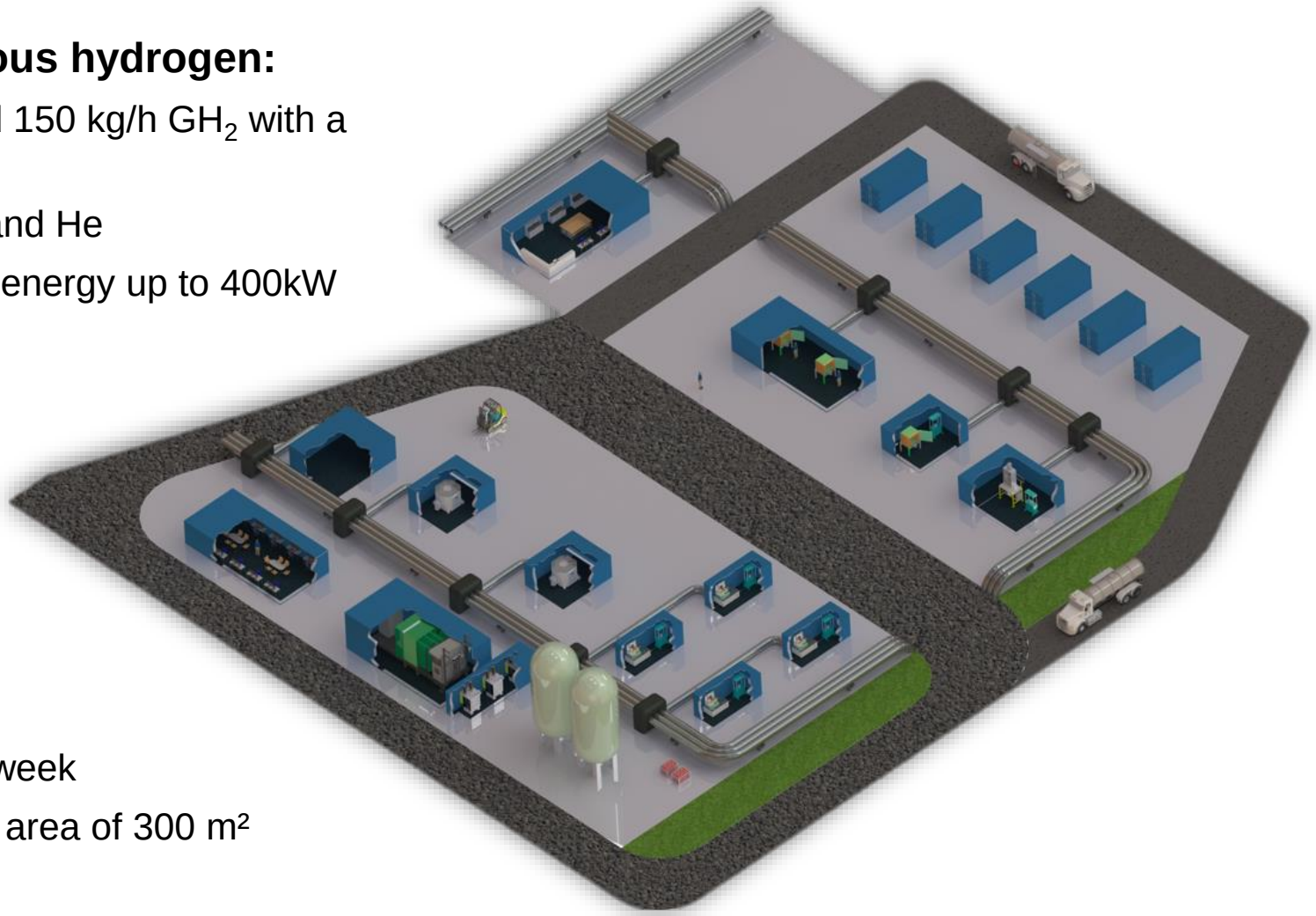
EFRE, EU & Ministry of Economics, Labor and Housing Baden-Württemberg

Project management: Heilbronn Region Economic Development Agency

Hydrogenium

Media Supply with green liquid and gaseous hydrogen:

- Reliable supply up to peaks of 500 kg/h LH_2 and 150 kg/h GH_2 with a maximum pressure of 300 bar
- Additional supply of every test bench with GN_2 and He
- Demand-based supply and delivery of electrical energy up to 400kW



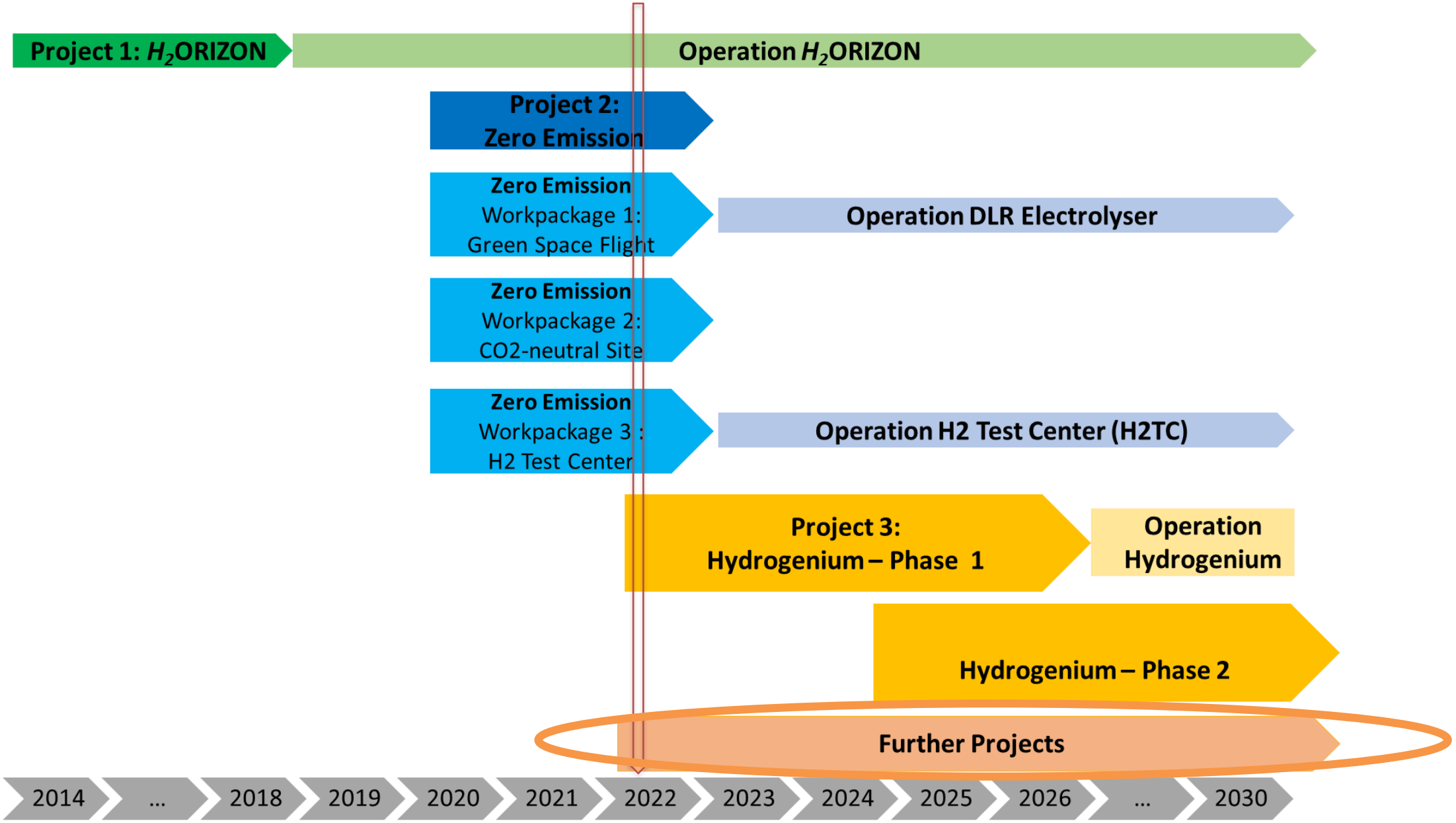
Services:

- Support in projects
- Support for erection and operation
- Preparation area

Hydrogen Cluster of Excellence:

- Opportunity of testing 24 hours a day, 7 days a week
- Flexible, container based test positions up to an area of 300 m²
- Open to all sectors/technologies

Outline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Further Projects

DO3228HEP LH2 flight demonstrator of MTU und DLR-FX

- Flight demonstrator of a FC driven DO228
- RA-AWT: Design und erection of a ground fueling station at DLR-FX airfield in Oberpfaffenhofen

A320 H2 Demonstrator of Lufthansa Technik

- Ground demonstration of operation of a FC system in an A320 plane with LH2 supply
- RA-PTE: Design of LH2/GH2 System incl. tank in plane
- RA-AWT: System simulation of the design (in parallel)

HYTAZER (HYdrogen TAnk ZERtifizierung)

- DLR internal Impulse project

BALIS

- Test platform for LH_2 driven fuel cell systems >1MW
- RA supports planning and erection of LH2/GH2 systems

KENTECH (Korean University in planning phase)

- Feasibility study of Fraunhofer concerning Liquification as research and lab topic

Systogen 100

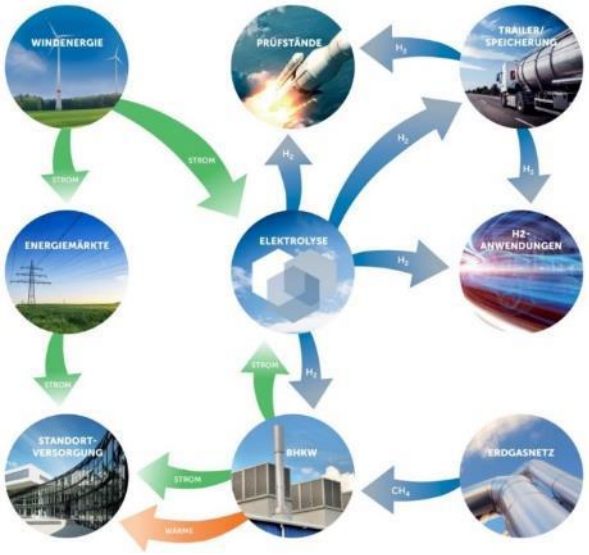
- LA as living laboratory

…

Summary & Outlook

- Expansion of test capacities and extension of the test portfolio for applications from the maritime, aviation, mobility and energy sectors.
- On site production of green hydrogen.
- Further hydrogen projects with research and industry.

Thank you for our attention



Contact

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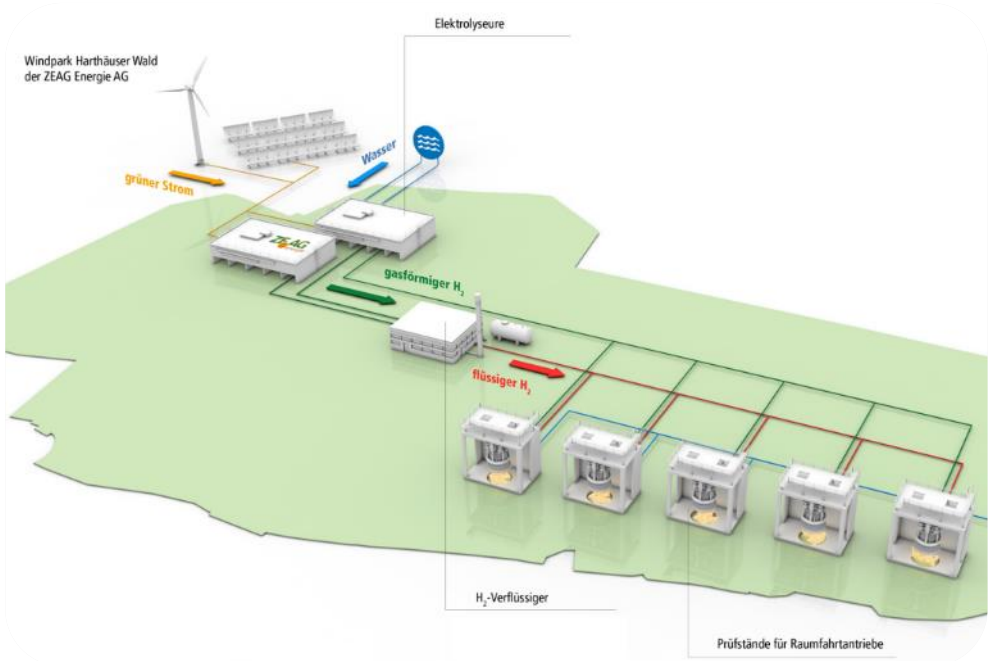
Additional Slides

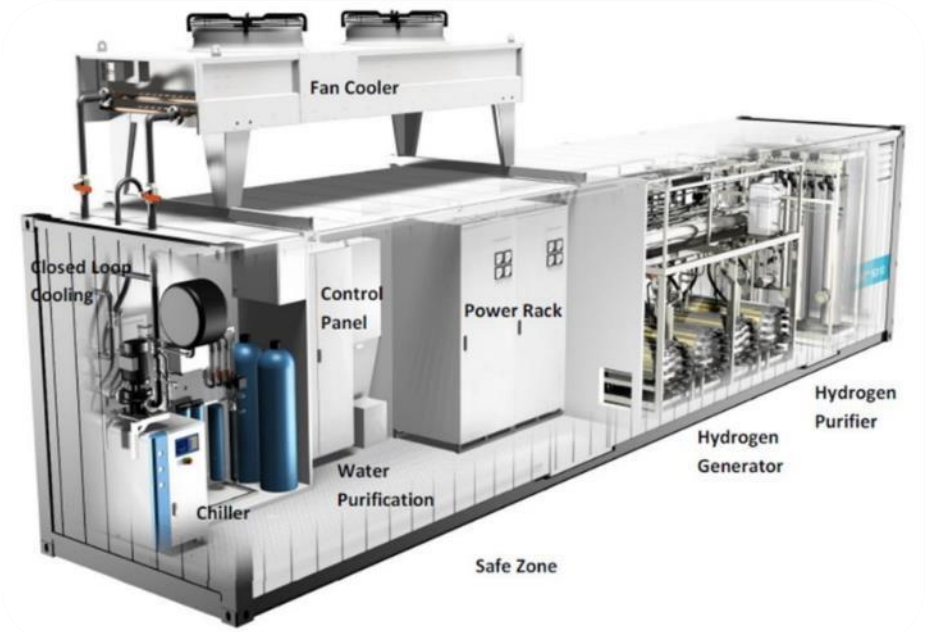
Aerospace technology transfer - Projekt H_2ORIZON

- ✓Sustainable energy supply with heat and electrical energy
- ✓Real laboratory of the energy transition
- ✓Fuel for emission-free mobility
- ✓Research platform for hydrogen applications
- Nucleus for a hydrogen economy/region

Zero Emission – Grüne Raumfahrt

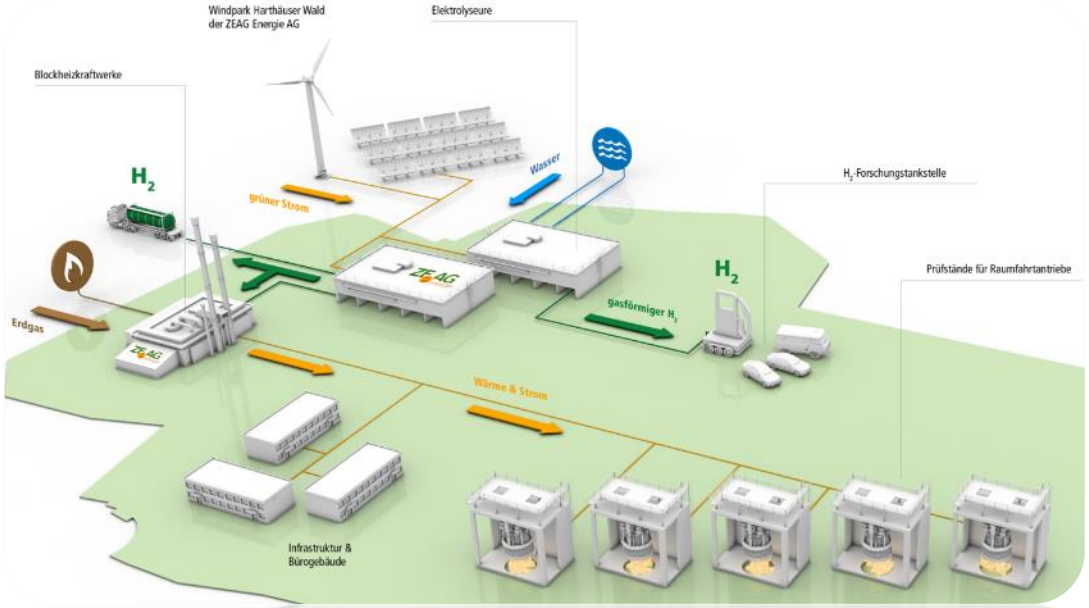
- 2,3 Megawatt (elektrische Leistung) PEM-Elektrolyseur (max. 35,8 kg/h grüner, gasförmiger Wasserstoff)
- Betrieb mit regenerativem Strom aus lokalen Anlagen (Hardthäuser Windpark)
- Versorgung des H2-Containertechnikums und des H2-Verflüssigers Ausgangsdruck bei ca. 30 bar
- Zusätzliche Einbindung des erzeugten Wasserstoffs in die bestehende Medieninfrastruktur





Zero Emission – CO2-neutraler Standort

- Beschaffung einer mobilen H2-Forschungstankstelle zur Betankung von Brennstoffzellenfahrzeugen bei 700 bar sowie Mobilitätsanwendungen bei 350 bar
- Integration von Messtechnik zur Erfassung aller Stoff- und Energieströme
- Beschaffung von zwei Brennstoffzellenfahrzeugen (Hyunday Nexo und Toyota Mirai)
- Ausstattung der Fahrzeuge mit zusätzlicher Messtechnik (Druck, Temperatur, CAN-Signale) zur Analyse des Betankungsvorgangs
- Standortversorgung mit Strom und Wärme durch H2-Beimischung in BHKWs



H2CT

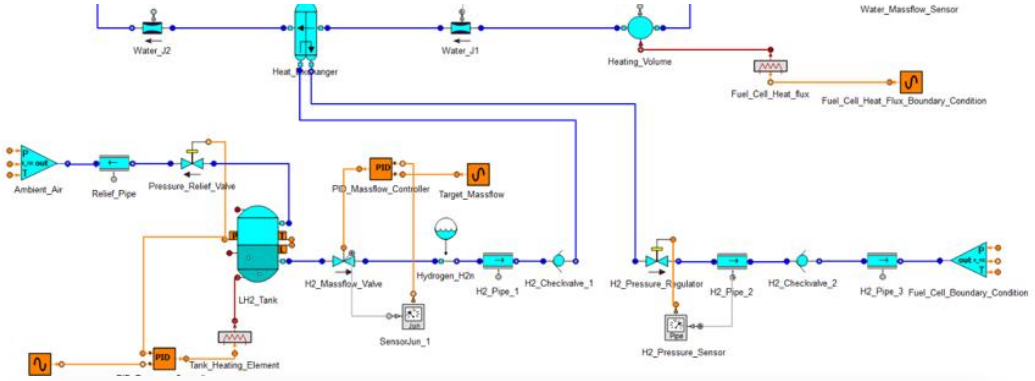
Medienversorgung	
Wasserstoff	5 Testpositionen: 30bar bis 60$\frac{kg}{h}$
	1 Testposition: 300bar bis 30$\frac{kg}{h}$
	LH2-Speicher optional
Stickstoff	Purging 5bar bis 65 $\frac{kg}{h}$
	Command pressure 7bar bis 30 $\frac{kg}{h}$
Erdgas	(nur Aurelia)
DI-Wasser	3 $\frac{l}{h}$ (pro Testposition)
Spannung	400 V
Elektr. Leistung (Bezug/Abgabe)	500 kW

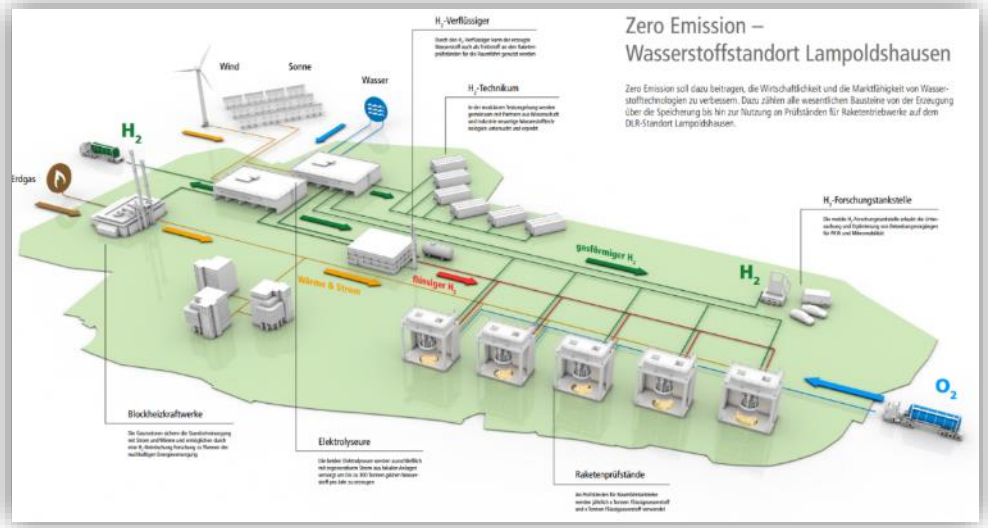
Tasks of Department Applied Hydrogen Technologies

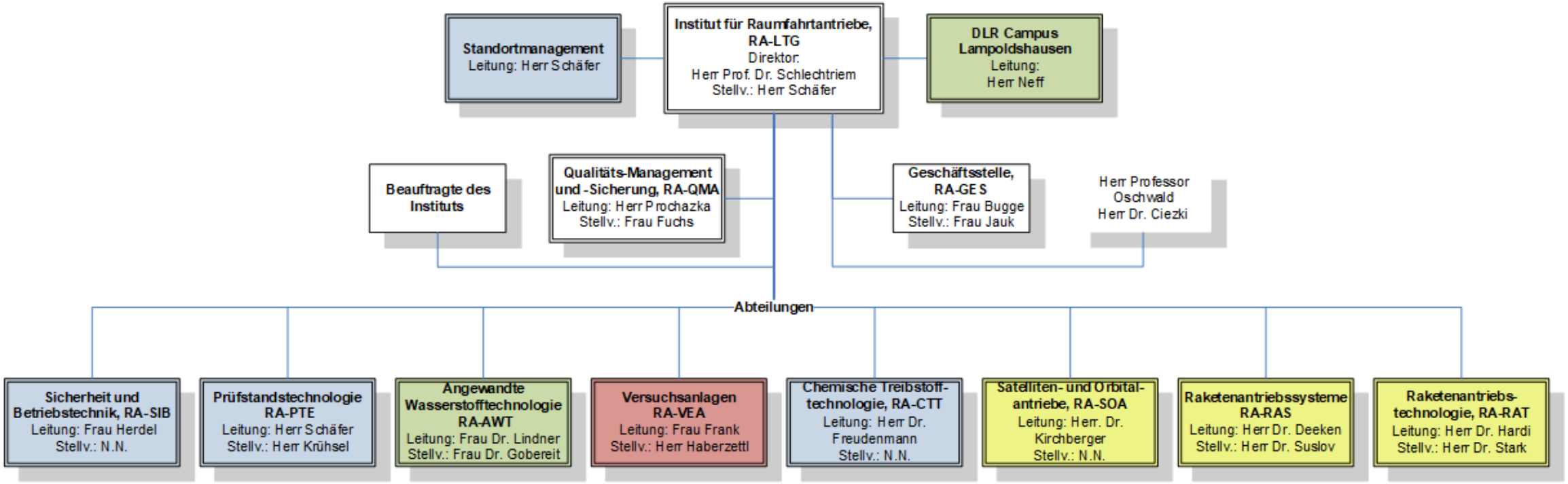
- Link to the other departments, enabler of technology transfer projects
- System simulation of LH_2/GH_2 power trains and H_2 Systems
- Operation of the H_2 Technical Center
- Safety Considerations
- Conceptional Design of H_2 systems and test stands
- Support with erection and operation of H_2 facilities

Goals:

1. Development of technology transfer projects with hydrogen systems
2. Development of test capacities for hydrogen technology demonstrators in industry & research







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Zero Emission – Hydrogen Site Lampoldshausen

The project stands for the **production** and **use** of **green hydrogen** under the energy-intensive conditions of the DLR Test Center for Space Propulsion.

Green space flight: Production of liquid and gaseous hydrogen from wind energy

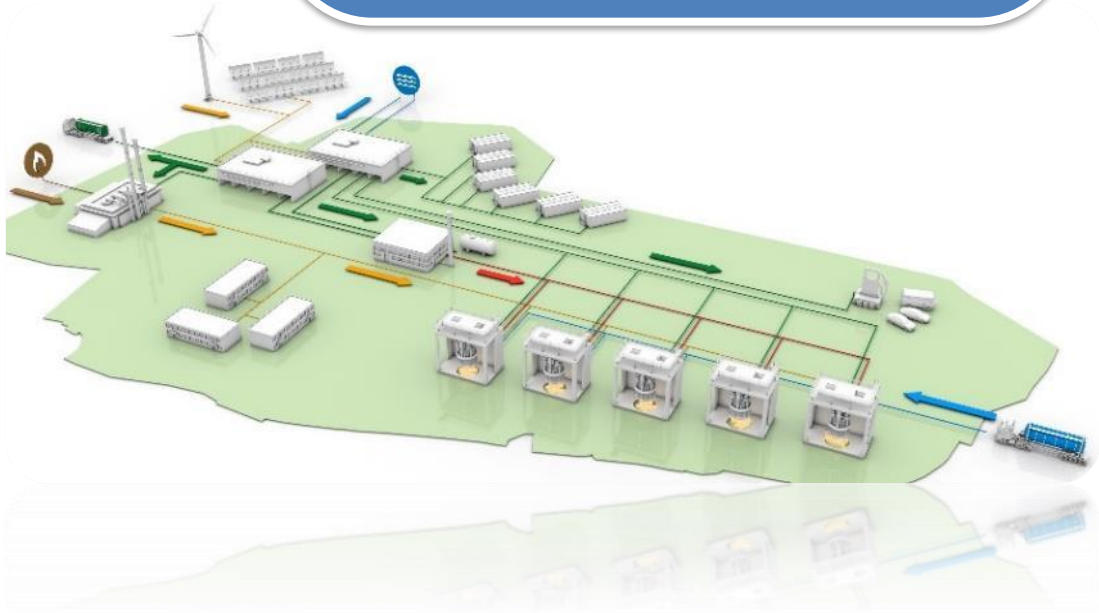
CO_2-neutral site: Measures to avoid CO_2 at DLR's Lampoldshausen site

H_2-container technical center: Modular and flexible test environment for H_2 technologies

Realization framework

Project duration: 05/2020 to 12/2022

~16 Million € Funding
Ministry of Economics, Labor and Housing Baden-Württemberg



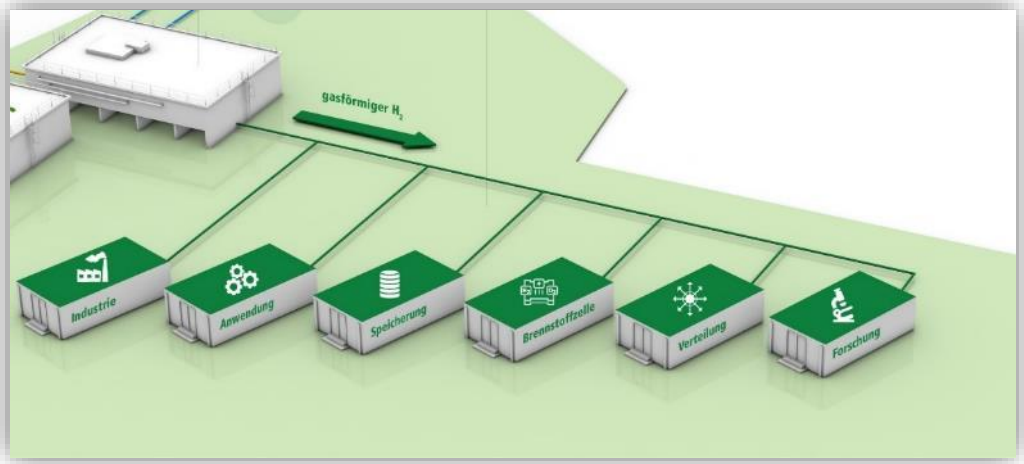
Zero Emission – H_2 Test Center

Construction of a modular, flexible test environment for hydrogen technologies

- Container-based test bench according to customer requirements
- Supply of green hydrogen
- Initial research projects:
  - Fuel cell in continuous operation
  - Micro gas turbines
- Study: Demand analysis of medium- and long-term requirements for test capacities for H_2 applications

Technology comparison "Electrolysis“

- Extension of the existing PEM electrolysis plant (H_2ORIZON) with measurement technology
- Comparison study with an AEL plant



Project partner & customers

Freudenberg Sealing Technologies

J.A. Becker

ZEAG Energie AG

Zentrum für Sonnenenergie- und Wasserstoffforschung BaWü