Transport Research Arena

TRA 2024, Dublin/Republic of Ireland

April 16th_0615pm_Hall 3a

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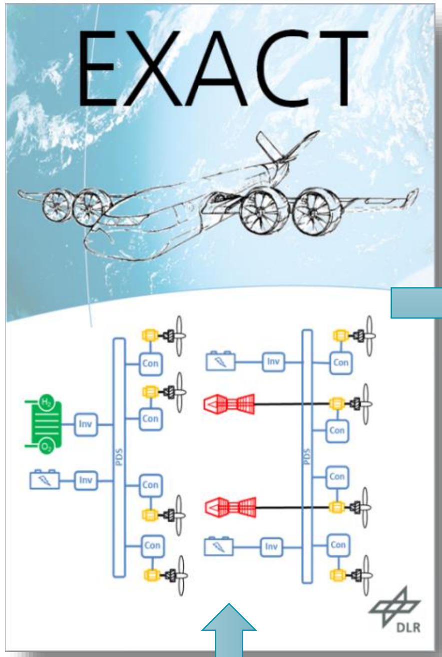
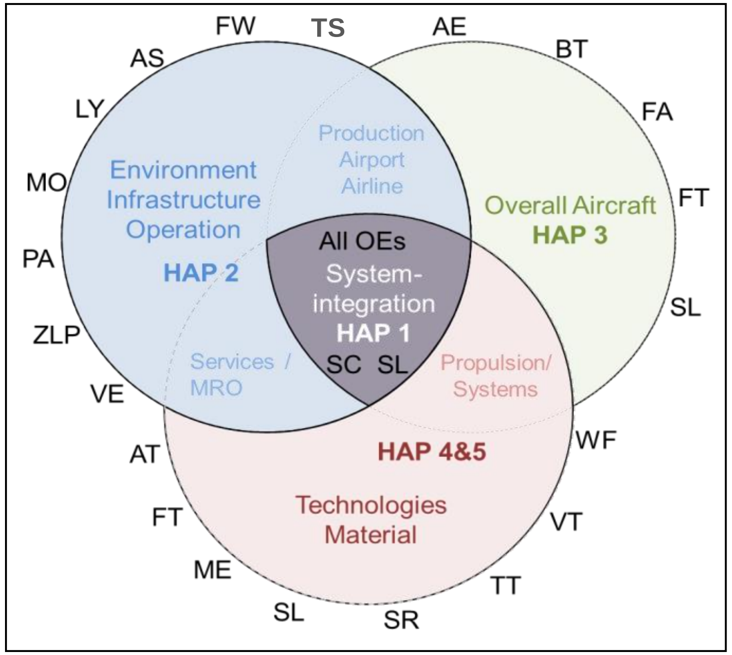
April 16th 2024

Analysis of airport infrastructure with regard to the use of sustainable and alternative aviation fuels

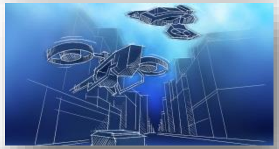
Concepts & Technologies for climate neutral flight

DLR project EXACT: 2020 – 2023; EXACT2: 2024 – 2026
Cross domain, 20 DLR Institutes, 112 Employees

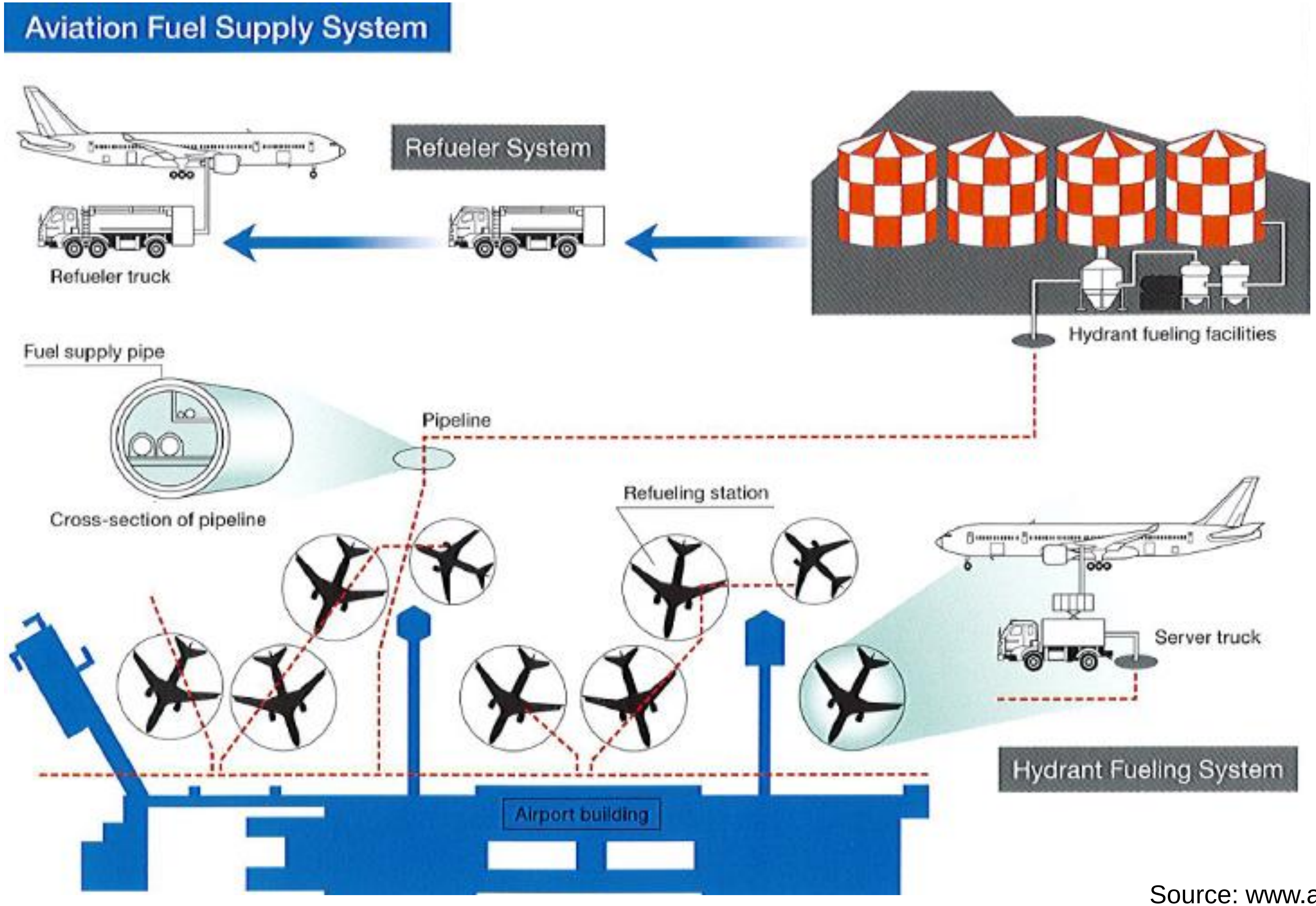


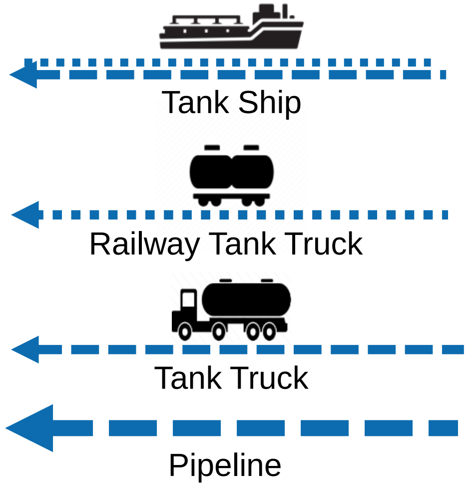


- Identify **aircraft concepts** and **enabling technologies** for climate neutral flight & define respective **technology roadmap**
- Assess **future air transportation systems** with respect to total energy lifecycle, climate impact, society, infrastructure, value for stakeholders, etc.



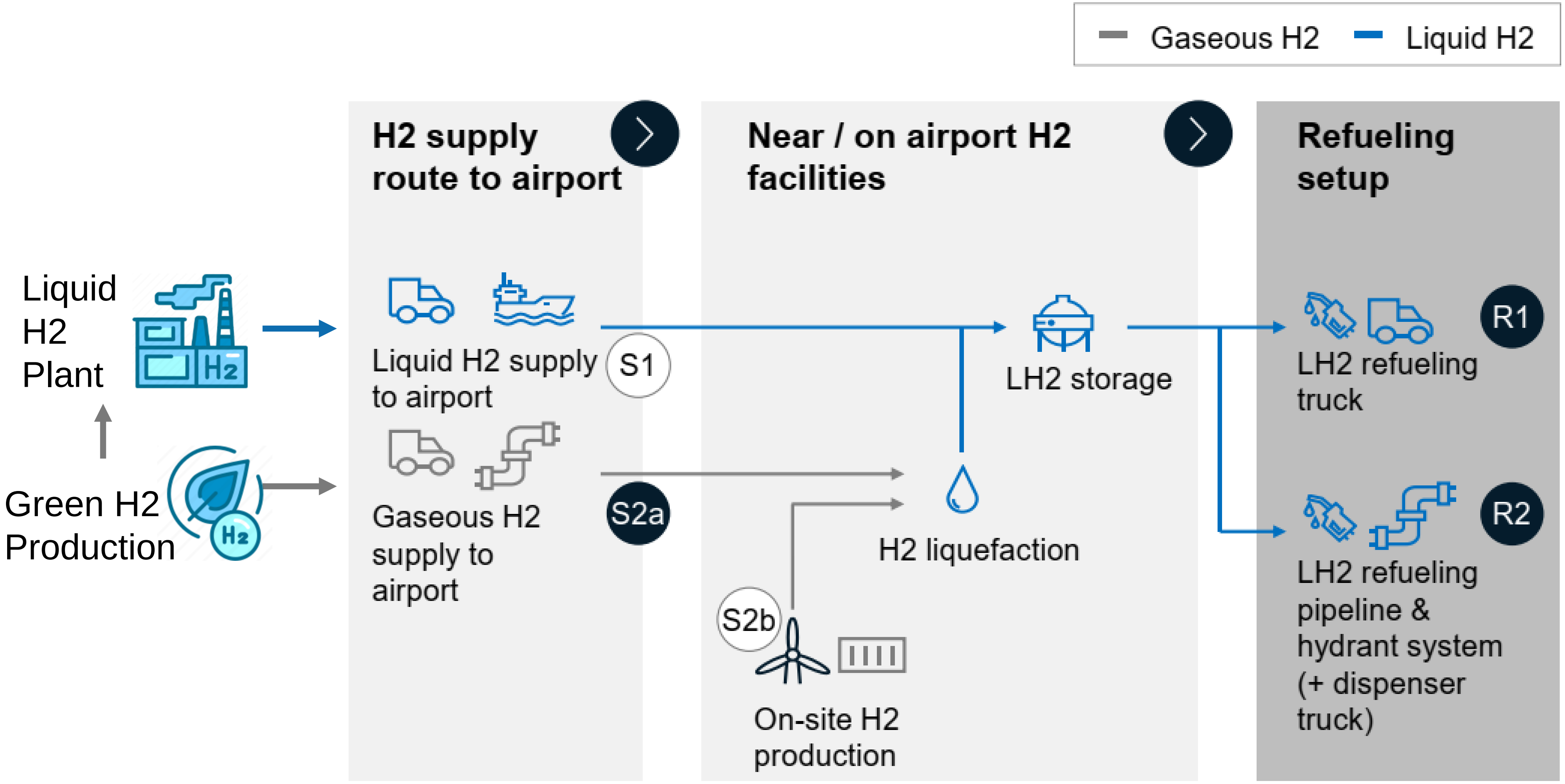
Aircraft Fueling on the Airport (Kerosene) - Overview





Source: www.aviation.stackexchange.com/

Topologies for Hydrogen (H2) supply routes and LH2 refueling setups at airports



Source: J. Hoelzen et al. (2022)

Future Airport Infrastructure Analysis – German Airports
Data based on the "DLR - Air traffic forecast & LH2 demand modelling"*

German Airports		Hydrogen in t 2040	per day*	2045	per day*	2050	per day*
MUNICH	MUC	12.380	33, 8	997	199 50	1709	341 85
FRANKFURT	FRA	12.328	33, 8	954	190 48	1603	320 80
BERLIN	BER	6.950	19, 5	543	108 27	922	184 46
DUESSELDORF	DUS	5.421	14, 4	432	86, 22	737	147 37
HAMBURG	HAM	4.189	11, 3	329	65, 16	560	111, 28
STUTTGART	STR	2.449	6, 2	194	38, 10	324	64, 16
COLOGNE	CGN	1.944	5, 1	145	29 7	242	48, 12
HANNOVER	HAJ	1.198	3, 1	92	18, 5	155	30, 8
NUERNBERG	NUE	589	1,6	48	9, 2	82	16, 4
BREMEN	BRE	527	1,4	41	8, 2	68	13, 3
DRESDEN	DRS	418	1,1	37	7, 2	63	12, 3
LEIPZIG	LEJ	299	0,8	24	4,8 1	41	8,1 2
MUENSTER/OSNAB.	FMO	180	0,5	15	2,9	24	4,8 1
DORTMUND	DTM	137	0,4	8	1,5	11	2,1
KARLSRUHE	FKB	111	0,3	9	1,7	14	2,8
SAARBRUECKEN	SCN	103	0,3	8	1,6	13	2,5
FRIEDRICHSHAFEN	FDH	88	0,2	8	1,6	14	2,7
PADERBORN	PAD	70	0,2	5	0,9	7	1,4
WESTERLAND	GWT	37	0,1	4	0,7	6	1,1
HAHN	HHN	34	0,1	2	0,3	2	0,4
MEMMINGEN	FMM	22	0,1	2	0,3	3	0,5
WEEZE	NRN	22	0,1	1	0,1	1	0,2
LAAGE	RLG	17	0	2	0,3	2	0,4
ERFURT	ERF	13	0	1	0,2	2	0,3

IATA guidelines for the minimum requirements for airport kerosene stocks (e.g. 5 days for LH2)

* Per Day ~ 365 days: no peaks

Liquid hydrogen (4tons per Truck)

Airports with higher demand

Airports with demand of one truck once/twice a week/a month

Connection to the Rail ?

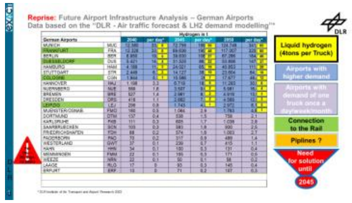
Piplines ?

Need for solutions until 2045

* Data from DLR Institute of Air Transport and Airport Research 2022

Main Challenges for Airports with LH2 infrastructure

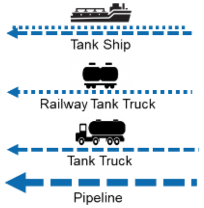
- **Fuels stocks in case of unexpected events:**
  IATA guidelines for minimum requirements for airport kerosene stocks
  (estimated 5 days supply of LH2 for FRA in 2045*~ 1,000 tons; in 2050* ~ 1,700 tons

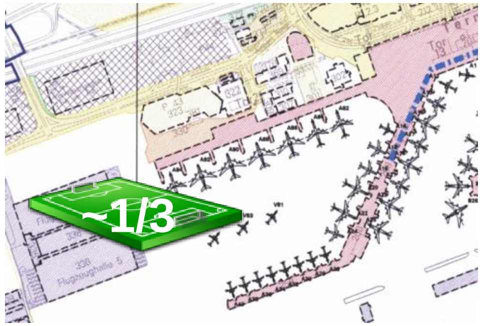


Source: NASA

- **Open Space requirements for fuel tanks storing**
  Actual largest LH2 storage takes around 2,300 m² of space storing for 270 tones LH2

- **Hydrogen demand vs. mode of transport**: a variety of ways including pipeline, truck, ship or train. Each method has its advantages and disadvantages, depending on the distance, the amount of hydrogen transported and the logistical challenges.





Source: FRAPORT

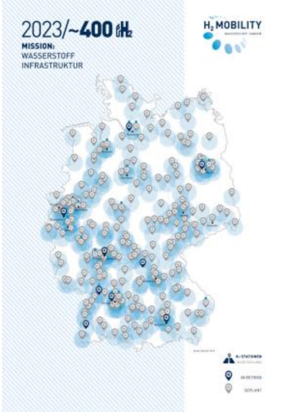
- **Liquid hydrogen plant vs plants convert gaseous hydrogen into liquid green hydrogen**
  Liquid hydrogen plant with output of 10 MW in liquid hydrogen (1 ton p.h up to 30 tons /p.d.)
  Status 2020; e.g. plant in Leuna capacity of 300t/d, but **grey** LH2
  Converting plants is producing up to 600 tons of LH2 per year (e.g. Iwatani company/Japan)

Source: LINDE

- **High investment for Infrastructure:** The transport of hydrogen requires an appropriate infrastructure, e.g. Liquid hydrogen plant (20-30 Mill. €)

Source: Iwatani

- **Transporting large amounts of hydrogen requires careful planning, safety measures, technological innovation and investments --> Overall planning**



Source: H2 MoBILITY

* DLR Institute of Air Transport and Airport Research 2022

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Impressum

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Date: 2024-04-16

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