

Hydrogen Refuelling Stations and Role of Utilization Rates: Key Messages and Issues

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IEA Hydrogen Roadmap Europe Workshop,

IEA HQ, Paris, July 10, 2013



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Key Messages Hydrogen Distribution and Refuelling Stations for Transport

- All hydrogen delivery options are technically feasible – there are no technical issues that cannot be overcome
- There is no blueprint for the type of hydrogen delivery infrastructure that needs to be rolled out – everything is possible
- Best practical and economic combination depends on specific national, regional and local situation, especially in the pre-commercial phase – existing industrial hydrogen infrastructure, energy mix, energy prices, safety regulation ...
- CO₂ targets influence production mix, rollout strategy, and costs
- Standardisation is key to drive down the cost of hydrogen refuelling stations – this requires consistent and harmonised RCS, and standardisation of technical components and systems



Comparison H₂ delivery concepts

Distribution option	HRS size				
	Very small ≤ 80 kg/day	Small ~ 200 kg/day	Medium ~ 400 kg day	Large ~1000 kg/day	Very large ≥ 1000 kg/day
On-site electrolysis	On-site power requirement may become an issue: 400 kg/day ≈ 1 MW				
On-site reforming	Difficult to capture CO ₂		Required footprint for production facility is an issue		
CGH ₂ truck	Delivery of 300 kg up to potential maximum of 1000 kg per truck				
LH ₂ truck	Relatively large boil-off for demand levels in early markets				
CGH ₂ pipeline	Due to high investments pipelines are not likely in early markets unless already available				

Color coding:	 Very likely	 Possible	 Less likely
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- Differences in general applicability based on main differentiating characteristics, or the most demanding or problematic requirements
- Examples: CAPEX, amount of hydrogen per delivery, footprint (external safety zone), mitigation CO₂ emissions, ...



Key remaining issues regarding HRS

- Effective strategies for rapid increase of capacity utilisation of HRS
- Tension between desire for fast maximum market coverage (many small stations) and need for rapid optimization of the HRS business case (as little as possible stations with as large as possible capacity)
- Relatively low average HRS utilisation in a growing network because of need for continuous addition of new capacity (in discrete quantities)
- Combining of hydrogen with conventional filling stations, or not, and finding of locations with sufficient space for future expansion of capacity
- Proof of hardware reliability (compressors, hoses, nozzles, seals, ...) under conditions of intensive practical use
- Suitable method for periodic inspection and certification of the accuracy of H₂-meters, which is necessary to be able to sell hydrogen to customers
- Cost-effective monitoring method to be able to demonstrate that the quality of dispensed hydrogen complies with applicable quality standards



Back-up slides

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Key Messages on Status of Hydrogen with Focus on Transport Applications

- There are no technical barriers that cannot be solved – not technology development but market development is the main bottleneck
- Most major car OEMs have commercialisation plans
- Many commercialisation efforts are on-going and starting up (European H2 Mobility initiatives, SHHP, FCCJ, H2USA, ...)
- Renewed and increasing focus on hydrogen from the perspective of a sustainable energy system – renewable hydrogen offers a major option for making available of the energy from intermittent renewable sources, both for electricity applications, as well as for a wide range of non-electricity end-use applications of energy



Definition "pre-commercial phase"

Pre-commercial status may have varying definitions across the world. A pre-commercial stage may be considered as a first bridging step between initial demonstration activities and commercial operations. It covers moving from isolated demonstration sites towards a network density allowing to meet hydrogen fuel demand of 10,000 – 100,000 cars or the equivalent of <1% of the existing car population.



Hydrogen Distribution and Refuelling Stations Options

Production		Delivery		
		Distribution	Refuelling Station	
Central		CGH ₂	Truck	CGH ₂
			Pipeline	
		LH ₂	Truck	CGH ₂ LH ₂ & CGH ₂
On-site	Electrolysis	Water supply & Electricity grid		CGH ₂
	Reforming	Natural Gas pipeline		
		Liquid fuel tank truck		

CGH₂: Compressed Gaseous Hydrogen (for filling of 350 bar and 700 bar hydrogen)

LH₂: Liquid Hydrogen (for filling of 350 bar, 700 bar, liquid and cryo-compressed hydrogen)



H2 Mobility Germany

Standardisation effort for HRS

	Very small HRS	Small HRS	Medium HRS	Large HRS
Number of refuelling positions	1	1	2	4
Number of refuellings per hour per position	2.5	6	6	10
Number of back-to-back refuellings per refuelling position	0	1	1	10
Maximum waiting time to fuel consecutive cars	20 min.	5 min.	5 min.	n.a.
Number of consecutive hours to meet performance specifications	--	3	3	24/7
Average daily number of refuellings	10	30	60	125
Maximum daily number of refuellings	20	38	75	180
Maximum hourly hydrogen throughput	18 kg	34 kg	67 kg	224 kg
Average daily hydrogen throughput	56 kg	168 kg	336 kg	700 kg
Maximum daily hydrogen throughput	80 kg	212 kg	420 kg	1000 kg
Number of cars per station (approx.)	100	400	800	1600

Source: H2 Mobility, 70MPa HRS Standardisation – Functional description, V1.1 07-06-2010