

MEETING AFIR FOR LDV AND HDV IN A COST-EFFECTIVE WAY

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My safety and DE&I commitment:
Guaranteeing the safety of our hydrogen vehicles by proactively participate to working groups that are related to hydrogen safety of our vehicles.



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01

LEGAL BACKGROUND EU REQUIREMENTS AND MILESTONES

EU REQUIREMENTS

700 BAR : THE (NEAR) FUTURE LEGAL HDV FUELLING STANDARD



AFIR: Alternative Fuel Infrastructure Regulation (EU) 2023/1804

428 700-bar HDV stations	1000 kg / day minimum	23% Highway	77% urban	By 2030
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Article 6, Clause 3:
"The operator shall ensure that the station is designed to serve light-duty and heavy-duty vehicles"

MILESTONES

MILESTONE 1: HDV FUELLING BY 2030

Current Normal Flow: max. 60g/s



EU (PRHYDE)

60 kg in **10** minutes

100 g /s



USA (DOE)

60 kg in **10** minutes

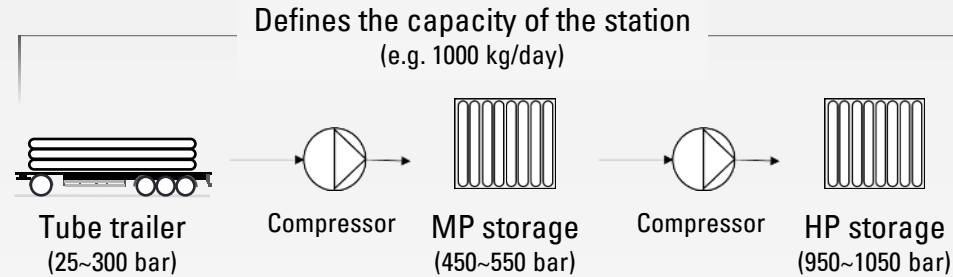
100 g /s



JP (NEDO)

60 kg in **10** minutes

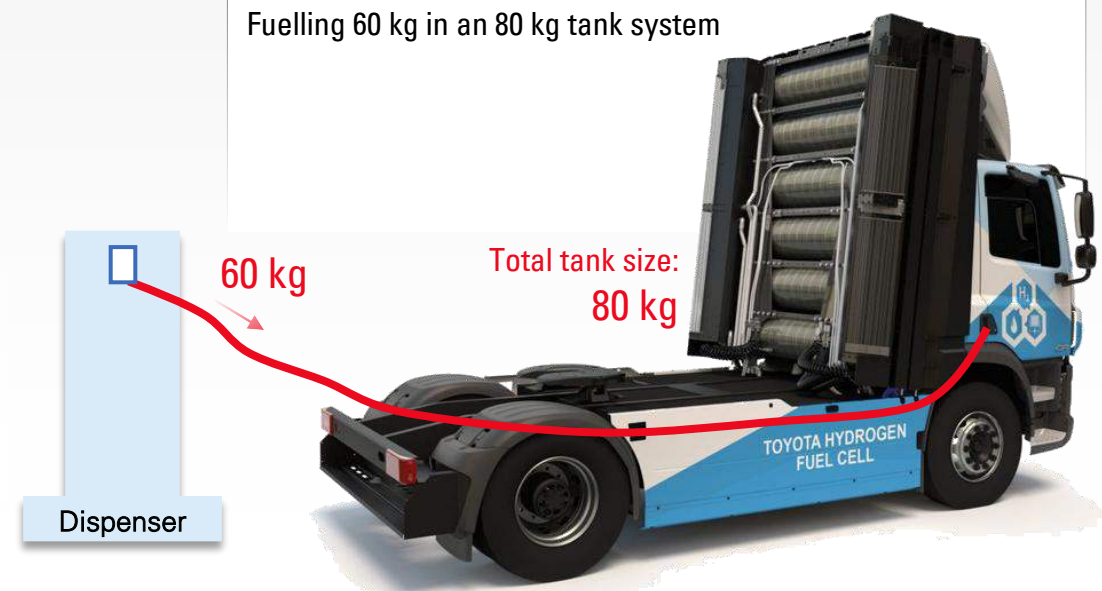
100 g /s



BASIC ASSUMPTION:
Fuelling 60 kg in an 80 kg tank system

Defines the filling rate of the station

- Flow control
- Precooling
- Pressure control
-

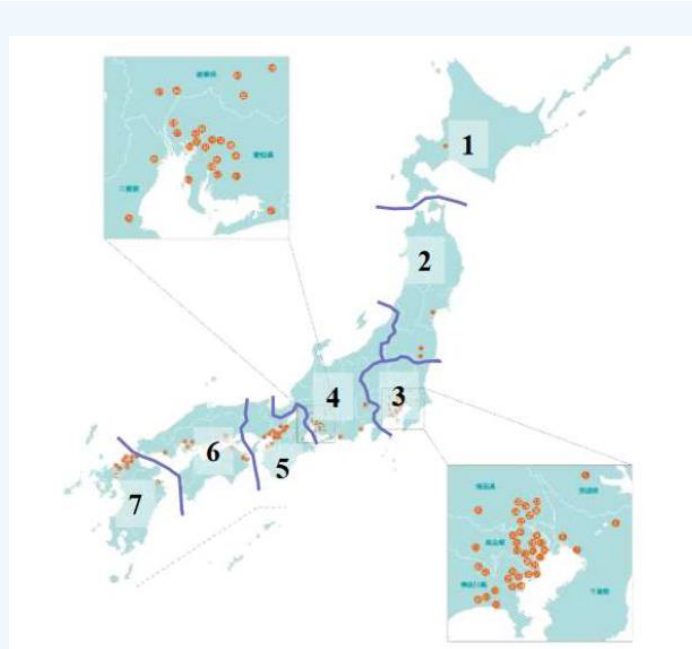


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CURRENT SITUATION EU LEGAL REQUIREMENTS AND MILESTONES

CURRENT SITUATION

#HRS AND #FCEV IN JAPAN AND EU



● JAPAN

160 HRSs (700 bar)
8,421 FCEVs
53 FCEV/HRS



🇪🇺 EU

187 HRSs (700 bar)
6,000 FCEVs
32 FCEV/HRS

Hydrogen take-off is too low in EU and Japan because HRS are not profitable
 station compatibility with HDV is beneficial

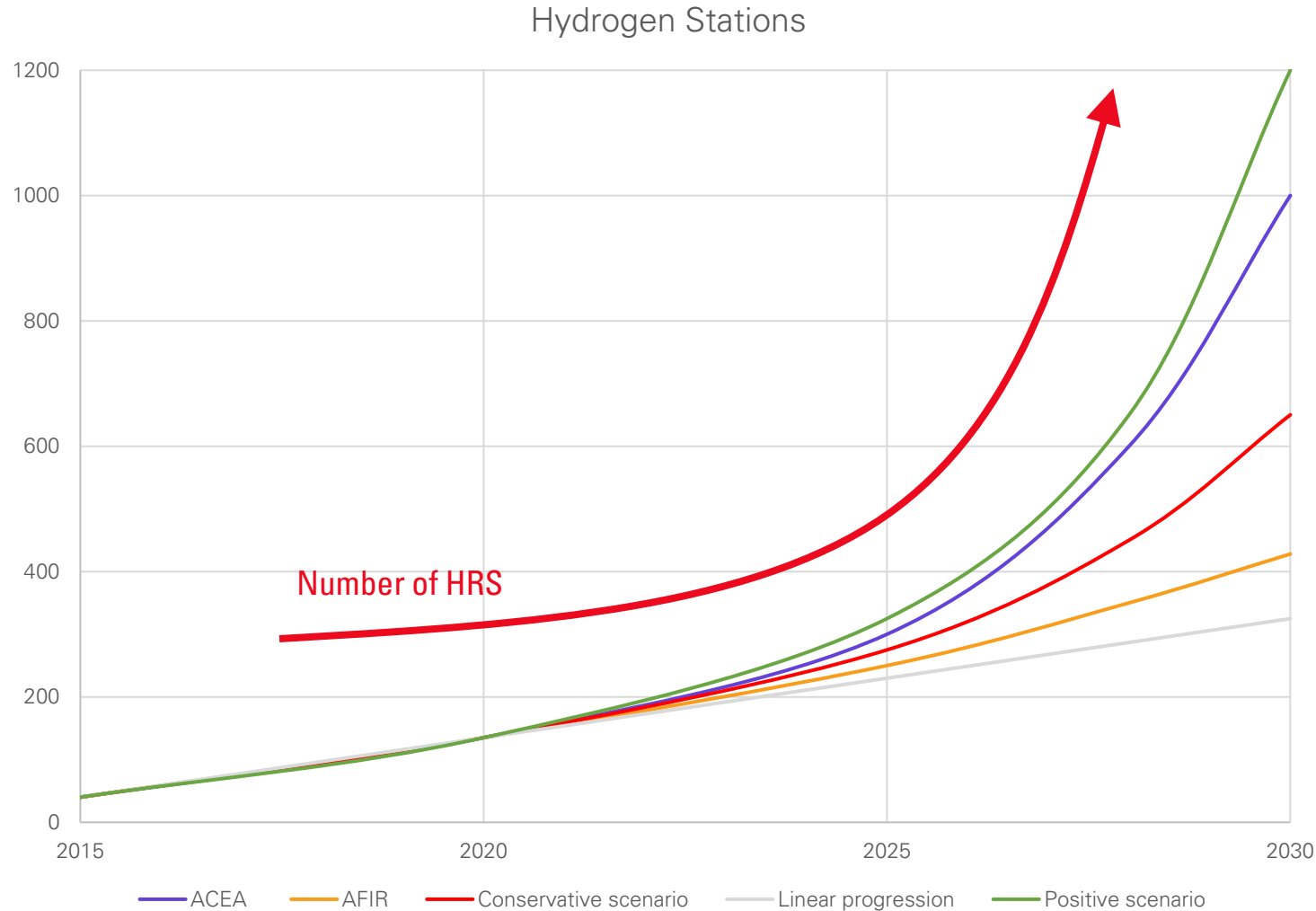
HRS: Hydrogen Refuelling Station
 LDV: Light Duty Vehicle
 HDV: Heavy Duty Vehicle



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PROGNOSIS

#HRS NEED TO INCREASE RAPIDLY



By 2030
 a rapid increase of HD stations is needed

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price of HRS
 should be reasonable



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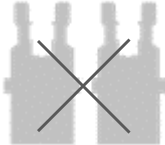
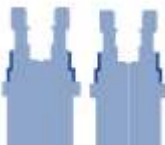






ACEA: ACEA's interactive map on hydrogen station proposal: [Link](#)
 AFIR: Hydrogen Europe calculation
 Scenario's: TME own investigation

03

STRATEGY TECHNICAL APPROACH & RECOMMENDATIONS

TECHNICAL APPROACH

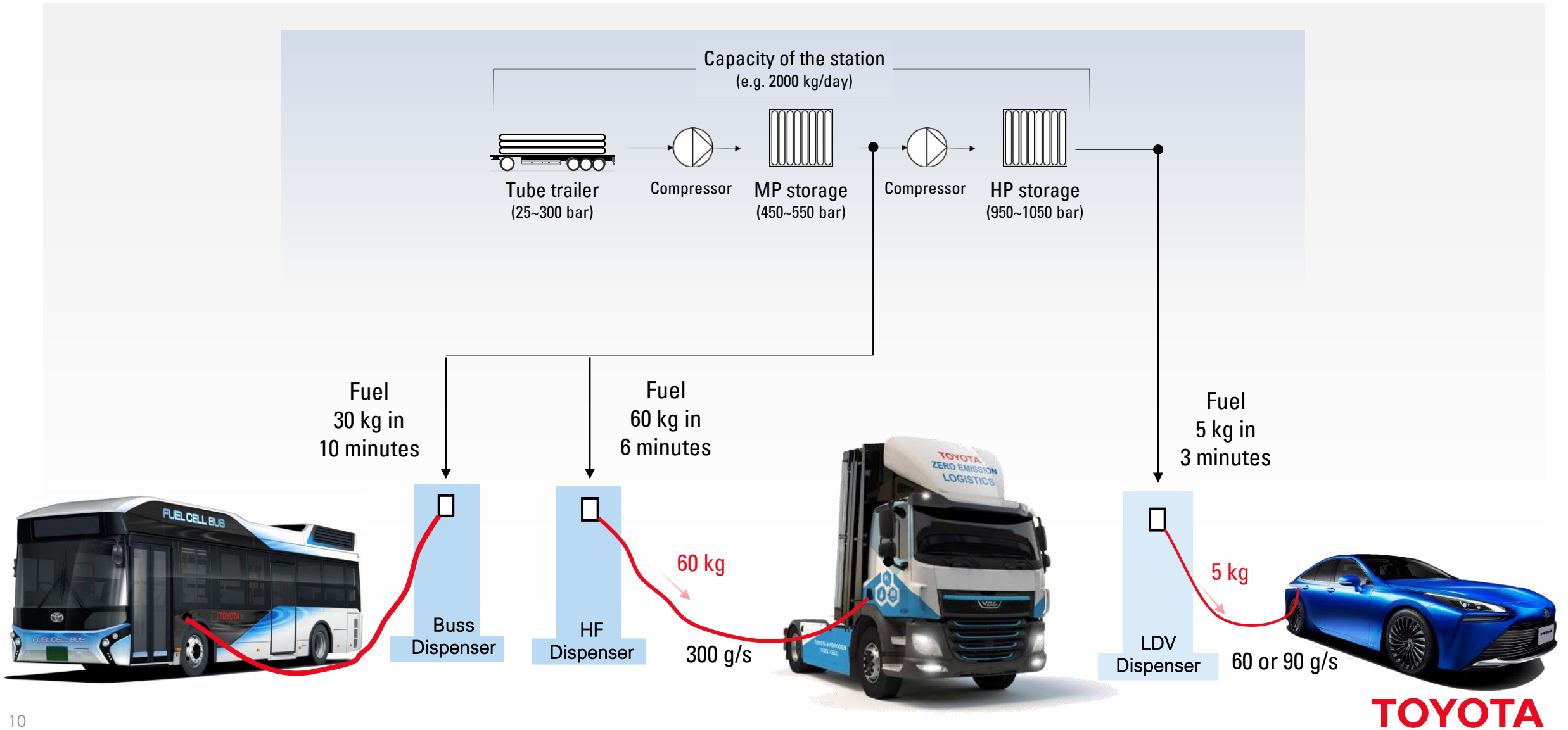
WHICH CONNECTOR TO USE FOR FUELLING HDV IN EU?

	H70_F60	H70_F90	H70_F60 x 2	H70_F90 x 2	H70_F300
					
	ISO 17268 →		ISO →		
Countries					
Common naming	Normal Flow	Mid Flow	Twin Normal Flow	Twin Mid Flow	High Flow
Maximum Flow Rate (g/sec)	60	90	120	180	300

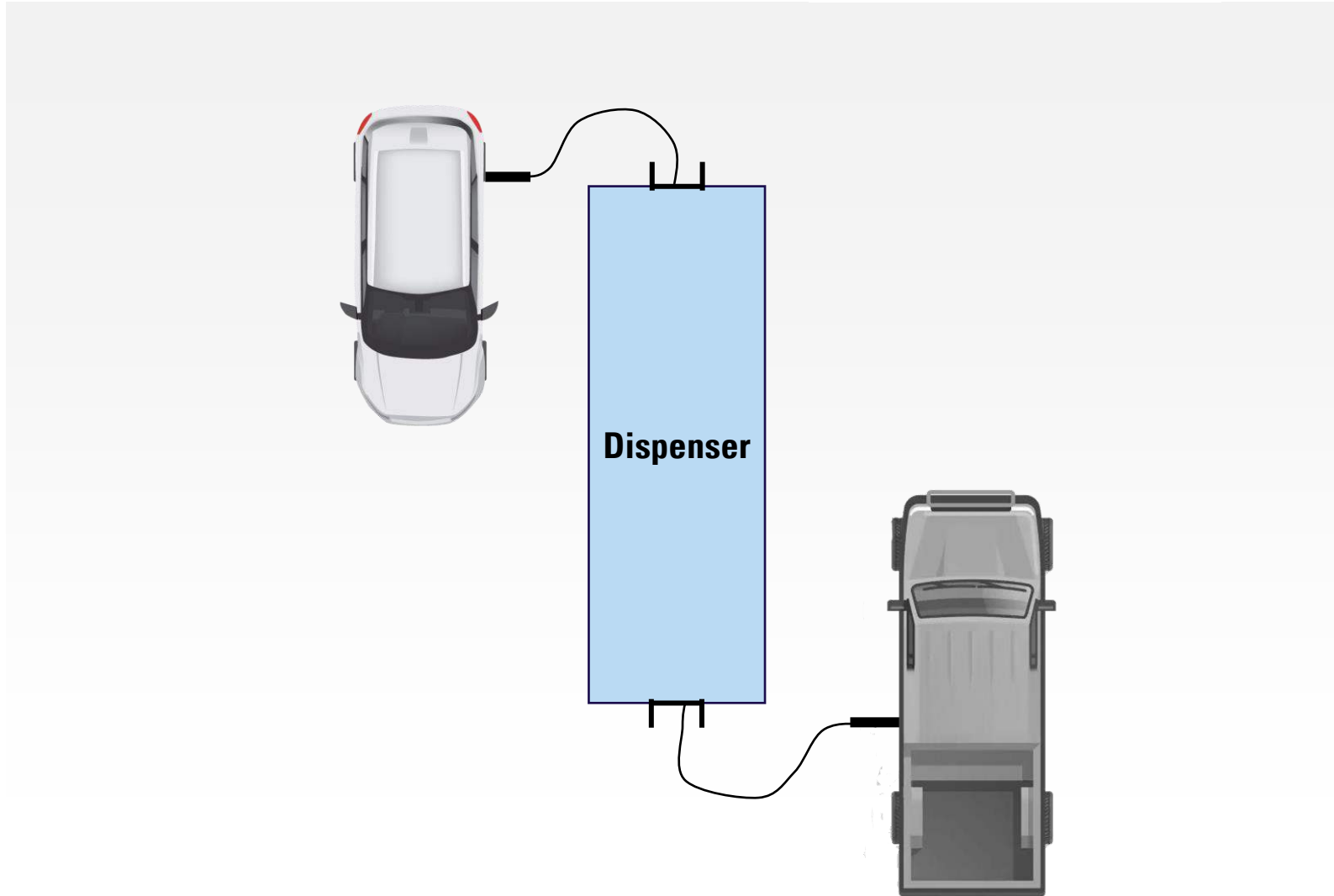
Tank size (kg)	Fuelling amount (kg)	Fuelling time in minutes (10 MPa / 20% → 80 MPa 95%)				
100	75	35	23	18	12	7
90	68	32	21	16	11	6
80	60 kg	28	19	14	9 Milestone ①	6 Milestone ②
70	53	25	16	12	8	5
60	45	21	14	11	7	4
50	38	18	12	9	6	4
40	30	14	9	7	5	4
30	23	11	7	5	4	4

TECHNICAL APPROACH

DO WE WANT THIS KIND OF STATION?



...OR JUST ONE DISPENSER FOR LDV & HDV!

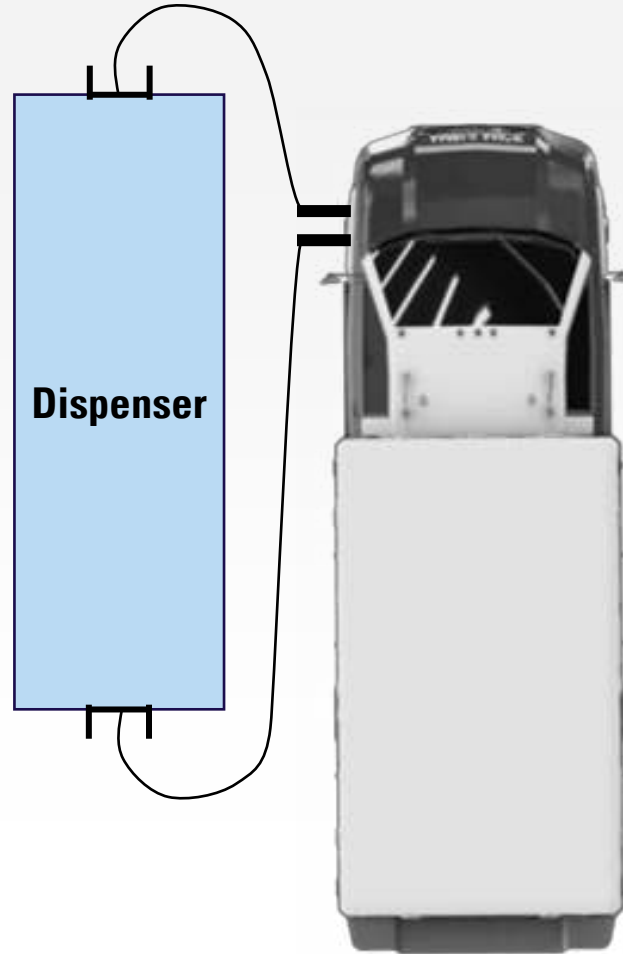


Dispensers with 2 nozzles are already existing



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...OR JUST ONE DISPENSER FOR LDV & HDV!




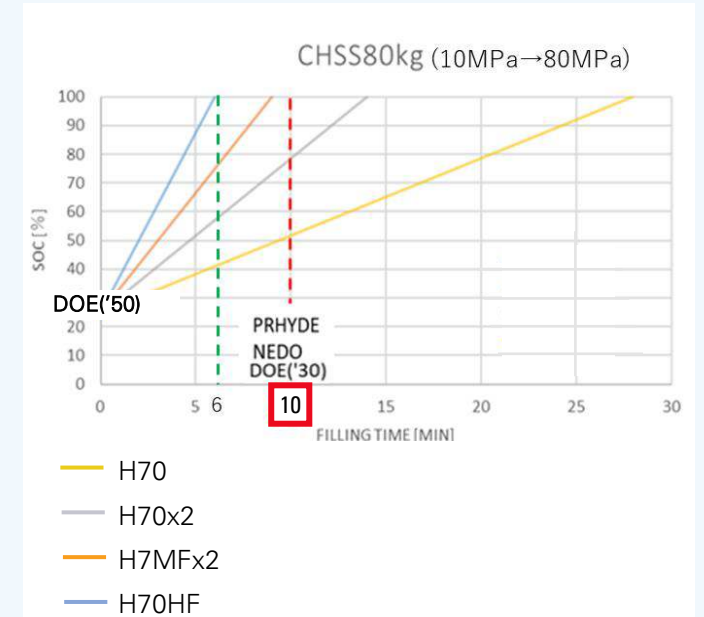
In Europe,
stations that fuel both
LDVs and HDVs are
standard practice.



TECHNICAL APPROACH

HD HRS TARGETS USING FUTURE TECHNOLOGIES

		H70_F60	H70_F60x2	H70_F90 x 2	H70_F300
Fueling speed (g/s)		60 Normal	120 Normal Dual	180 Mid Dual	300 High
Fueling speed target @2030	60 kg in 10 minutes 	✗	✗	✓	✓
Usability	Compatibility w/F90 nozzle (Availability at existing HRS)	✓	✓	See next slide	See next slide
	Complexity of the filling process	✓	⚠ insert 2 nozzles	⚠ insert 2 nozzles	⚠ heavy nozzle
Cost	vehicle cost	✓	✓ + €€€	✓ + €€€	✓ + €€€€
	HRS (dispenser) cost	✓ €€€ k€	✓ x1.78	✓ x1.85	✗ x2.5~3.5
Reliability		✓	✓	✓	⚠ no track record



High Flow (F300)
dispenser cost is very high and HRS components still need to be developed.

TECHNICAL APPROACH

FCEV – HRS CONNECTION

Only 1 dispenser needed to serve both LDV and HDV



= AFIR requirement

Current (NF) stations are fully compatible with Mid Flow vehicles.

ISO 17268 Compatibility			VEHICLE RECEPTACLE				
			H35-F60 (NF)	H35-F120 (HF)	H70-F60 (NF)	H70-F90 (MF)	H70-F300 (HF)
Station nozzle	H35-F60	(NF)	✓	✓	✓	✓	--
	H35-F120	(HF)	--	✓	--	--	--
	H70-F60	(NF)	--	--	✓	✓	--
	H70-F90	(MF)	--	--	✓	✓	--
	H70-F300	(HF)	--	--	--	--	✓

Current (NF) vehicles are fully compatible with Mid Flow stations.

PRACTICAL APPLICATION

FCEV - HRS CONNECTION

Nozzle suppliers are ready for MF.
HF nozzle still needs to be developed.



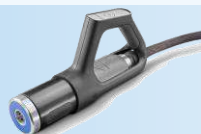
TATSUNO:

MF: Nozzle ready
HF: Under development



NITTO-KOHKI:

MF: Nozzle ready
HF: Under development



STAUBLI:

MF: Nozzle ready
HF: Under development



WALTHER:

MF: Nozzle ready
HF: No



WEH:

MF: Currently 3 mm design
HF: Under development

Same exterior receptacle dimensions
Only inner diameter is different

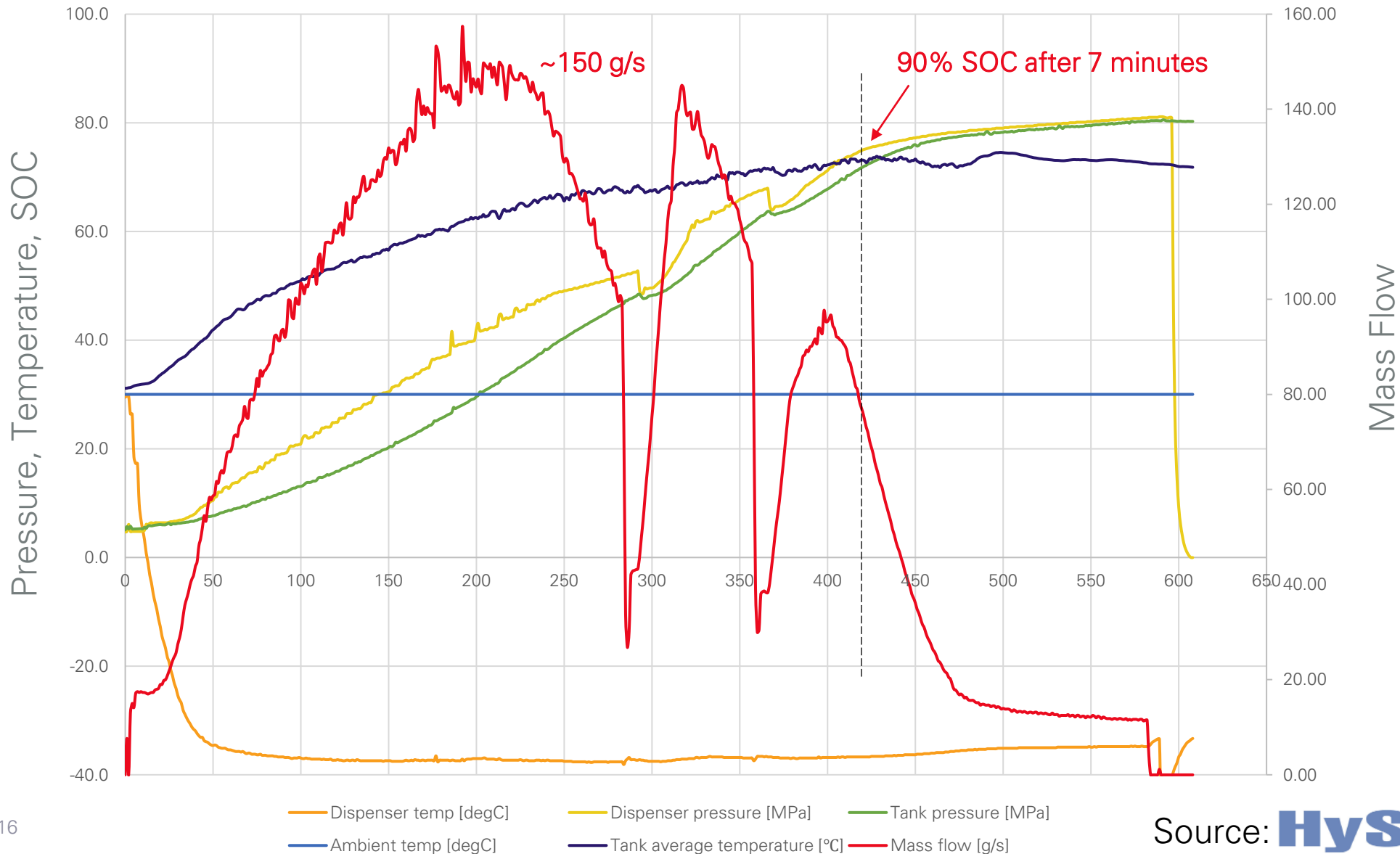
		NF (H70-F60)	MF (H70-F90)	HF (H70-F300)
Inner diameter (mm)		Φ3	Φ4	Φ8(TBD)
Start of demonstration		—	March 2023	TBD
Development Status	Station	—	Demo HRS in Namie Town, Fukushima	Under concept consideration
	Component for vehicles	—	Hino FC Truck Demo	Under concept consideration
Standard	Receptacle Protocol	ISO 17268 (up to 05/2024) SAE J2601:2020	ISO 17268-1 (05/2024) SAE J2601-5 (02/2024)	ISO 17268-2 (2026) ISO 19885-3 (2026)

↓
Parts available,
testing ongoing

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Development planned.
ISO postponed for 2027
No HF vehicles are currently
in prototype stage

PRACTICAL APPLICATIONS

FUELLING AN FC TRUCK IN LESS THAN 10 MIN.



Summer 2023, Fukushima
 Hino FC Truck ~1200L
 Tamb: 29.6°C
 Target APRR: 11.7 MPa/min
 P_{chss_initi}: 5.05 MPa
 P_{chss_end}: 80.6 MPa
 T_{chss_max}: 74.5 °C
 SOC_{end}: 96.8 %
 Fuelling time: 9 min 50 sec
 Refuelling amount: 45.8 kg

CONCLUSIONS & RECOMMENDATIONS



**Use Light
Duty
Vehicle
HRS
hardware
to fuel
Heavy Duty
Vehicles**

- 1 Twin Nozzle fuelling development will be faster than High Flow
- 2 60 g/s & 90 g/s fuelling methodologies are fully compatible
- 3 Twin Receptacle HD Trucks can fuel using a single nozzle HRS
- 4 Twin Nozzle dispensers can fuel current and future LDVs
- 5 Even if HDV move to High Flow, sLH2 or CcH2 after 2030, Twin Nozzle dispensers can be used for fuelling LDVs
- 6 Fully compliant with AFIR requirements as long as capacity is 1000 kg/day and along TEN-T highway or urban node

THANK YOU



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