TOYOTA APPROACH ON HEAVY DUTY REFUELLING

3rd JOINT CEP/NOW HEAVY DUTY WORKSHOP
21.04.2021

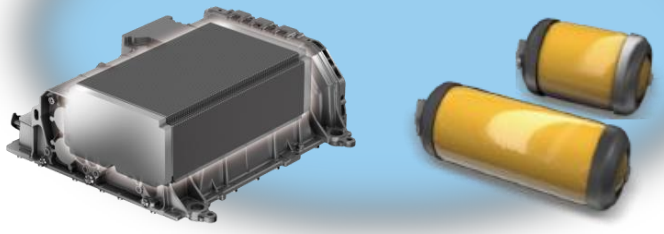
TOYOTA MOTOR NORTH AMERICA
Fuel Cell Development Department

Increase H_2 demand through diversification

Passenger Vehicles

Performance improvement and cost reduction

FC technologies



Increase demand

H HYDROGEN

Contribution to infrastructure development

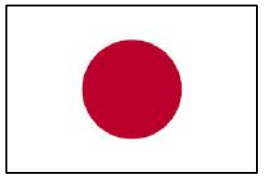
Commercial Vehicles

Substantial hydrogen consumption

Industrial use

70 MPa CH_2 is the current trend of HD transport

Provide solution to customer needs.



Kenworth Class 8 truck
Range: 450 km
70 MPa (Type 4)
60 kg

Hino Class 8 truck
70 MPa (Type 4)

Hino 25 ton
Range: 600 km
70 MPa (Type 4)

Medium duty
70 MPa (Type 4)
7.5 to 25 kg

Hardware vs fuelling time

Fueling Time (minute)		Connector									
		H70		H70MF		H70x2		H70MFx2		H70HF	
Maximum Flow rate (g/sec)		60		90		120		180		300	
Practical average flow (g/sec)		30		45		60		90		150	
ff (flow factor)		1		1.5		3		3		5	
V_station D (Station vol factor)		137	174	137	174	137	174	137	174	137	174
CHSS (kg)	Fueling amount (kg)	Fueling time = ⊿70MPa / (APRR_target)									
100	75	45	35	30	23	22	18	15	12	9	7
90	68	40	32	27	21	20	16	13	11	8	6
80	60	36	28	24	19	18	14	12	9	7	6
70	53	31	25	21	16	16	12	10	8	6	5
60	45	27	21	18	14	13	11	9	7	5	4
50	38	22	18	15	12	11	9	7	6	4	4
40	30	18	14	12	9	9	7	6	5	4	4
30	23	13	11	9	7	7	5	4	4	4	4

Note.

Fueling time and amount are assumed based upon the reference conditions of performanc

Reference conditions: Fueling from 10MPa (SOC20%) to SOC95% (80MPa)

Based on JPEC-S0003 T20 tables

Japan Led

Current in US

Japan Led

In development by Industry Group

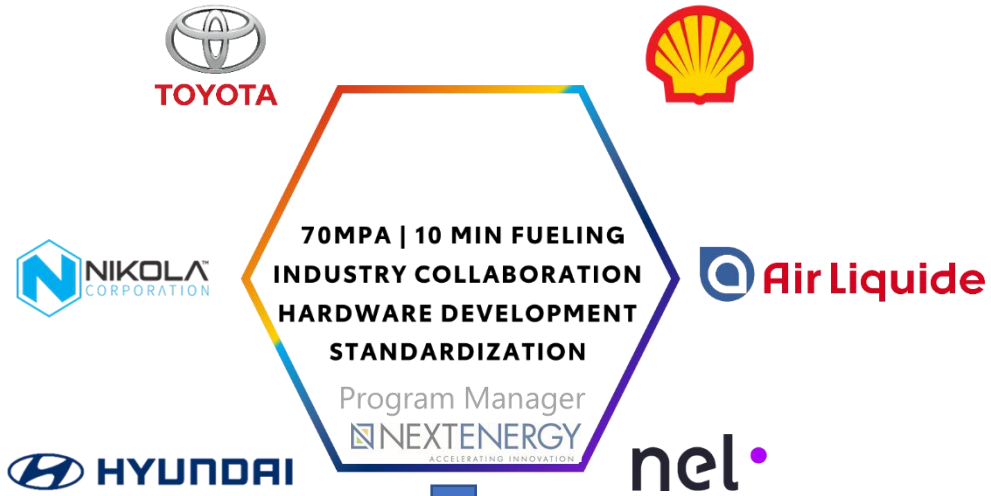
> 10 minutes

< 10 minutes

Industry Group plans to have a prototype H70HF nozzle by end of 2021

New development needed for 70 MPa HD fuelling

HARDWARE



input

ISO

05/2021 to 03/2024

ISO 17268

PROTOCOL

01/2020 to 12/2021

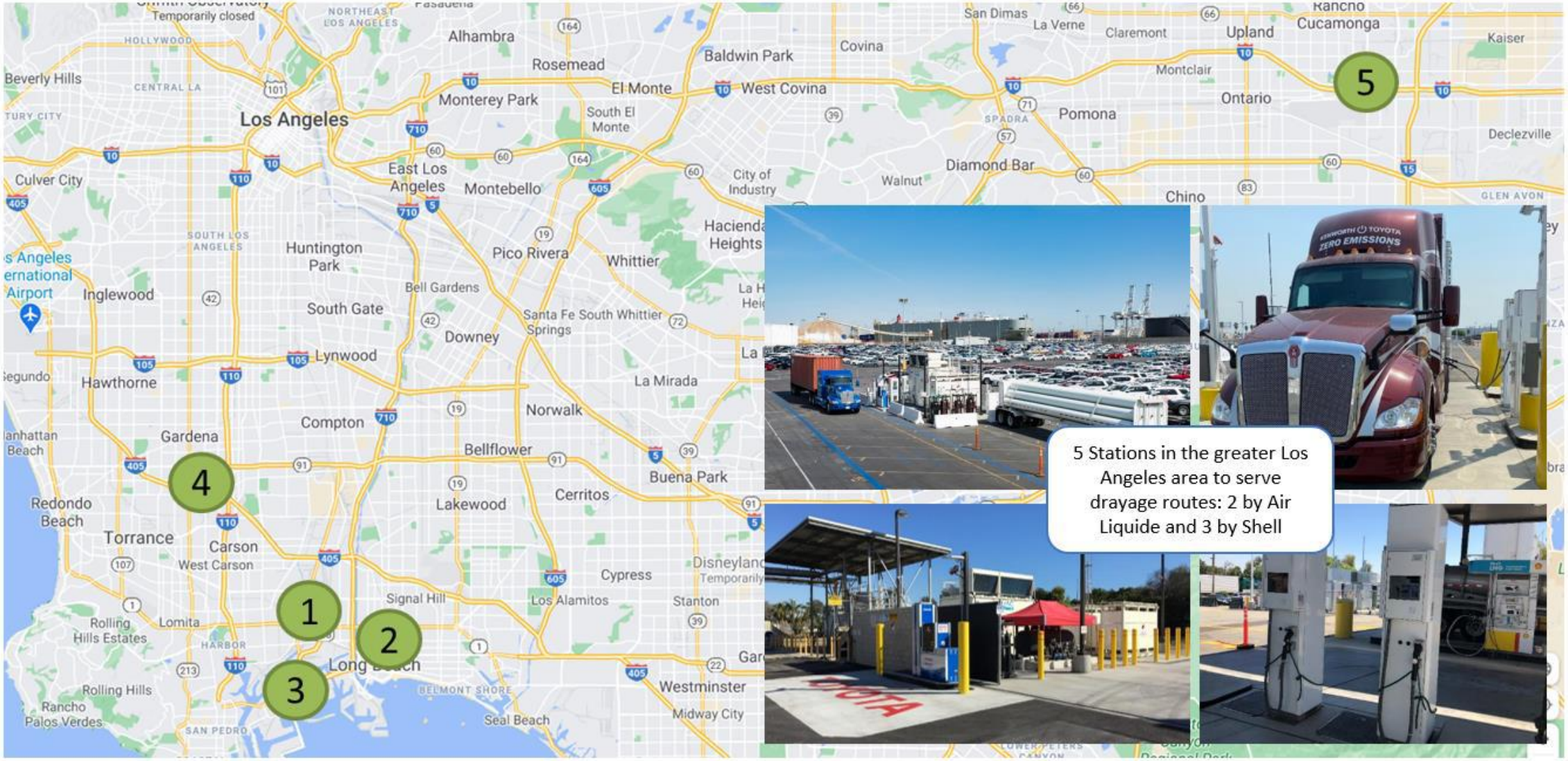
input

ISO

03/2021 to 03/2024

ISO 19885

Current US HD stations (2x H70)



HF nozzle and receptacle compatibility

ISO 17268 Compatibility		Receptacle			
		H35	H70	**H70MF**	**H70HF**
Nozzle	H35	**Yes**	Yes	**Yes**	**No?**
	H70	No	Yes	**Yes**	**No?**
	H70MF	**No**	**No**	**Yes**	**No?**
	H70HF	**No**	**No**	**No**	**Yes**

Participation to standardization for CH2

<u>WG24: Convenor: Antonio Ruiz [Nikola], Project Leader: Jackie Birdsall [Toyota]</u>
Topic: Gaseous hydrogen – Fuelling protocols for hydrogen-fuelled vehicles.

Summary is as follows:

- ISO 19885-1, Design and development process for fuelling protocols
- ISO 19885-2, Definition of communications between the vehicle and dispenser control systems
- ISO 19885-3, High Flow Hydrogen Fuelling Protocols for Heavy Duty Road Vehicles
    - Request to include both H70MF and H70HF

Work began March 2021

<u>WG5: Convenor: Livio Gambone [Nikola]</u>
- ISO 17268:2020, Gaseous hydrogen land vehicle refuelling connection devices
    - Request to include both H70MF and H70HF

Work will begin in May 2021.

THANK YOU