MOVET

Centro d'iniziativa per i MOtori, VEicoli e Tecnologie

Il ruolo dell'idrogeno nella transizione tecnologica ed ecologica dell'energia

17 dicembre 2021

Idrogeno e decarbonizzazione del trasporto pesante

FPT POWERTRAIN TECHNOLOGIES

Andrea Gerini
Advanced Engineering
andrea.gerini@cnhind.com

Where we are starting from: truck figures

6,2 Million trucks fleet

2% of the EU fleet

23% of the CO_2 emissions from the EU transport sector

Covering **73%** of all freight transported over land

13 year average age

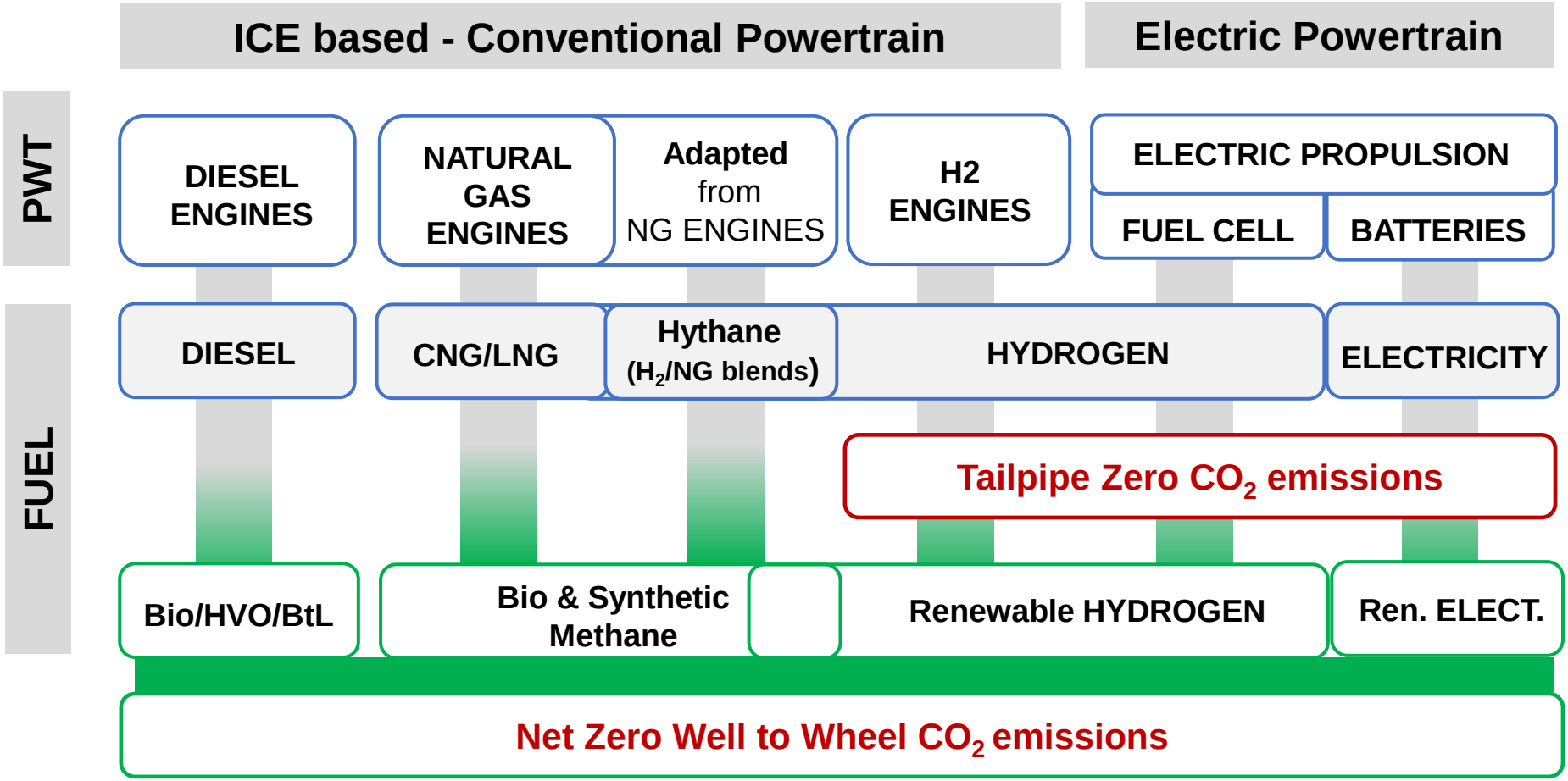
250 000
new trucks in 2020

0,5% hybrid+EV

2,9% alt fuels

Source: www.acea.auto/trucks

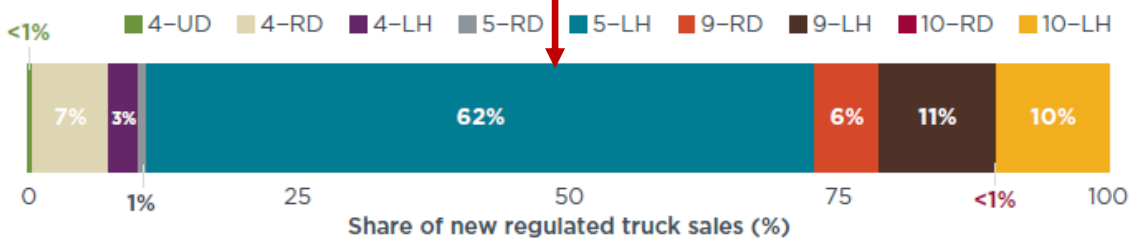
Pathways towards carbon neutrality



HDV CO_2 emissions regulation

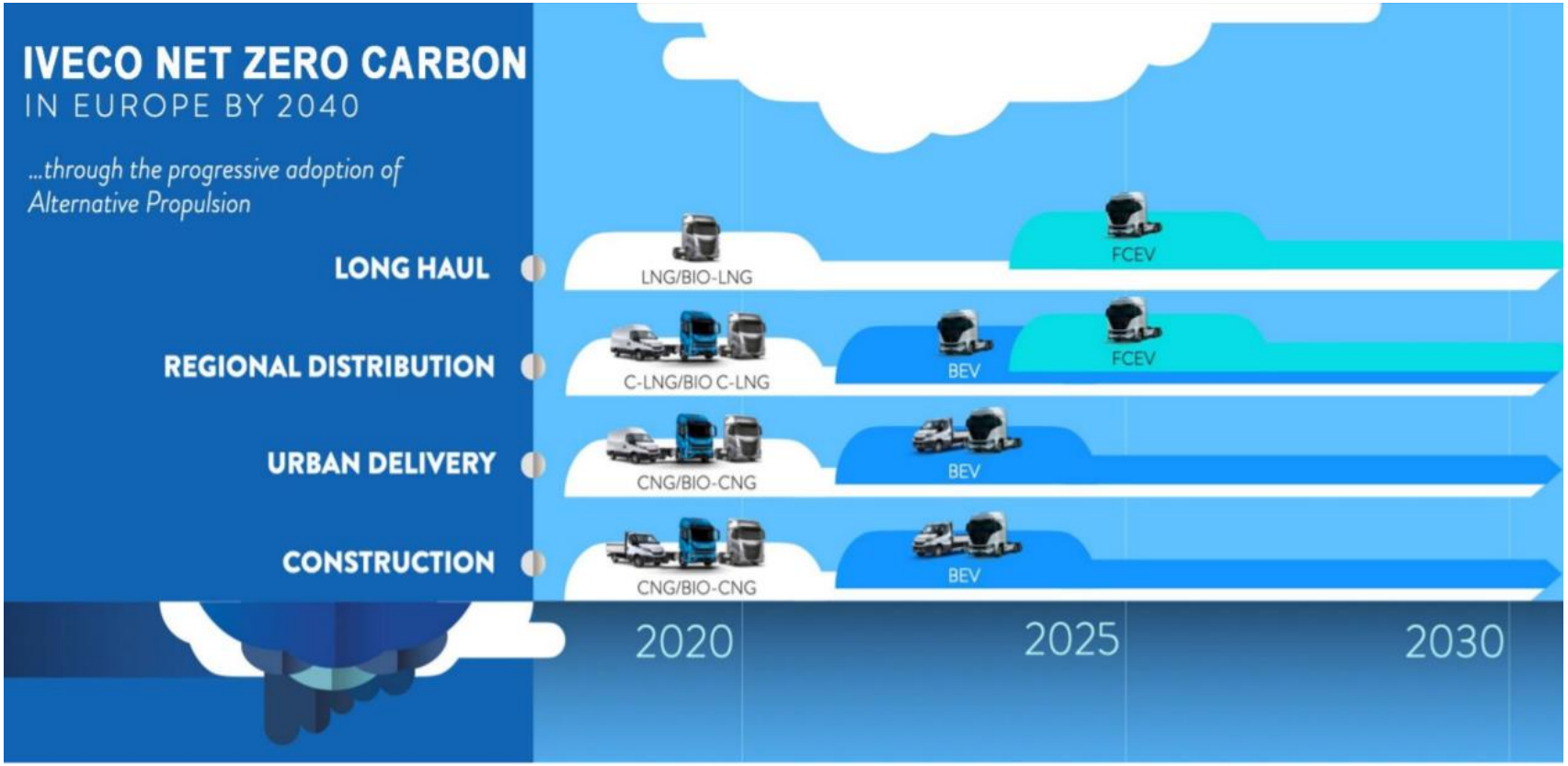
CO2 **tailpipe** emissions in scope of the EU 2019/1242 regulation

Group description	Group	Sub-group	Cabin type	Engine power	Reference annual mileage (km)	Average payload (tonnes)
Rigid, 4x2 axle, GVW > 16 t	4	4-UD	All	< 170 kW	60,000	2.65
		4-RD	Day cab	≥ 170 kW	78,000	3.18
			Sleeper cab	≥ 170 kW, < 265 kW		
		4-LH	Sleeper cab	≥ 265 kW	98,000	7.42
Tractor, 4x2 axle, GVW > 16 t	5	5-RD	Day cab	All	78,000	10.26
			Sleeper cab	< 265 kW		
		5-LH	Sleeper cab	≥ 265 kW	116,000	13.84
Rigid, 6x2 axle	9	9-RD	Day cab	All	73,000	6.28
		9-LH	Sleeper cab		108,000	13.4
Tractor, 6x2 axle	10	10-RD	Day cab	All	68,000	10.26
		10-LH	Sleeper cab		107,000	13.84



Source: ICCT – Sept 2021

Towards net zero emissions



IVECO

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How to best use H_2 for HD applications: FC or ICE ?

*When comparing **H_2 ICEs** to hydrogen **Fuel Cells**:*

PRO

- **Limited engineering effort for ICE integration**, especially when a full electrified vehicle platform is not already available or feasible;
- **Competitive vehicle payload** as with Natural Gas solutions;
- Less stringent requirements to **hydrogen purity grade**;
- Less sensitive to **ambient conditions**. Heat rejection is much lower compared to FC.

CONS

- **Local pollutants** still present even if at ultralow level;
- **Lower powertrain efficiency** (impact on fuel operating cost);
- Higher **acoustic emissions** compared to an electric powertrain.

TCO comparison results strongly related to external factors
(e.g. H2 price) and technology evolution (efficiency gap and cost).

H_2 ICE: main challenges

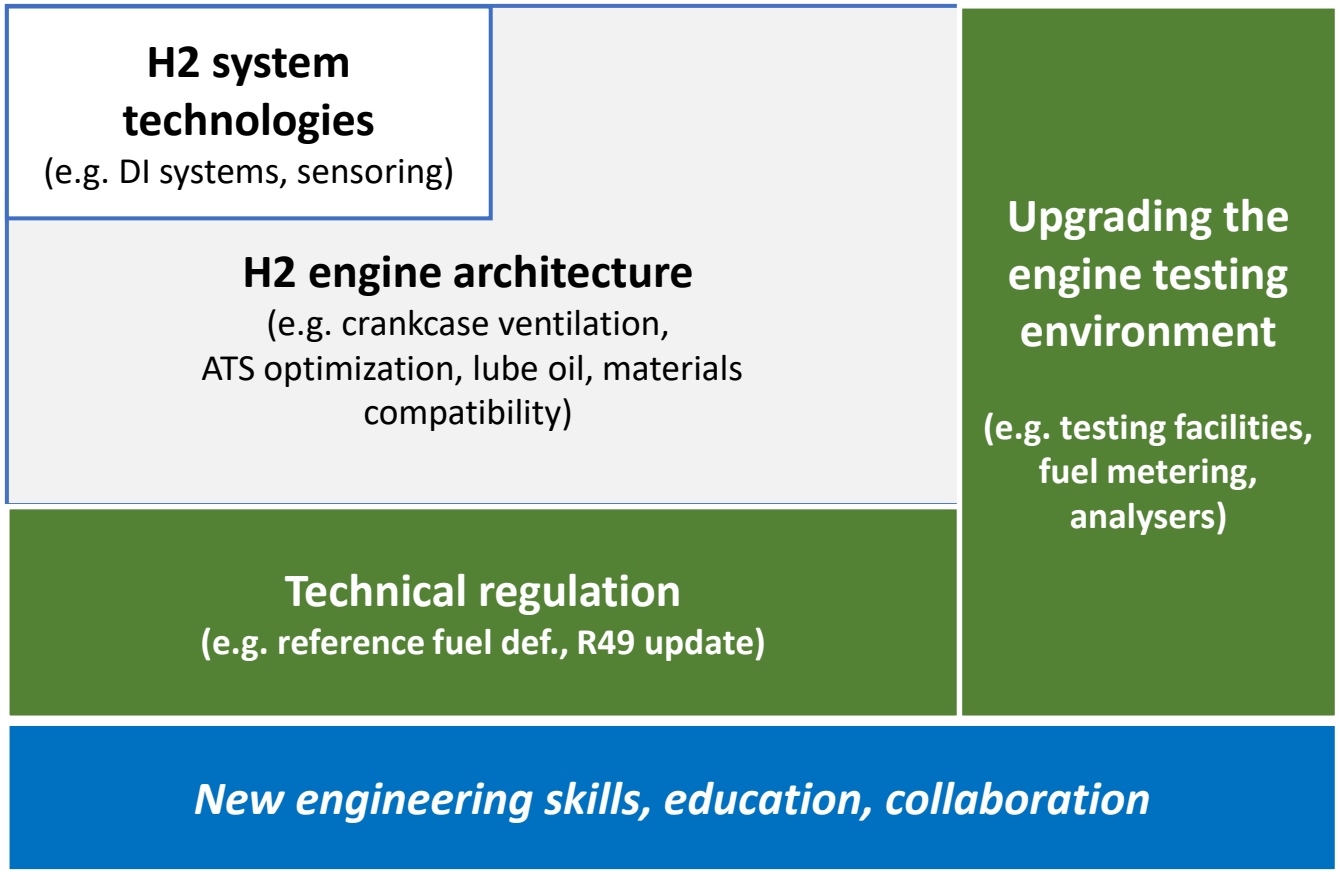
Due to its **wide inflammability range** and **low ignition energy**, hydrogen combustion process is challenging.

Issue	Approach	Technology
Controlling combustion process Preventing abnormal combustion (knocking, pre-ignition)	**"Diluted" charge**	**Turbocharger adaptation Peak Cylinder Pressure Dedicated ignition system Lube oil formulation**
Avoiding back-fire phenomena	**Direct Injection system** PFI more critical	**DI injectors** PFI injector integration/injection duration
Tackling low power density	**Direct Injection system**	**Displacement increase High TC rate**
Safety	**Crankcase ventilation system Material compatibility**	**Scavenging pump Dedicated materials**

How to best approach H_2 ICEs

	CNG/LNG	Hythane (NG/H2 blends)	H2 dedicated ICE
Injection system	PFI		Low/Mid Pressure DI
Ignition	Spark Ignited (dedicated system for H_2)		
Combustion approach	λ = 1	λ = 1	Lean/Ultralean
Power density	Ref (> 25 kW/l)	=	=
Thermal efficiency	Ref	=	++
Aftertreatment system	3-way cat		DeNOx system but NOx engine raw emissions level expected much lower than Diesel at lambda >2

Supporting H_2 technologies



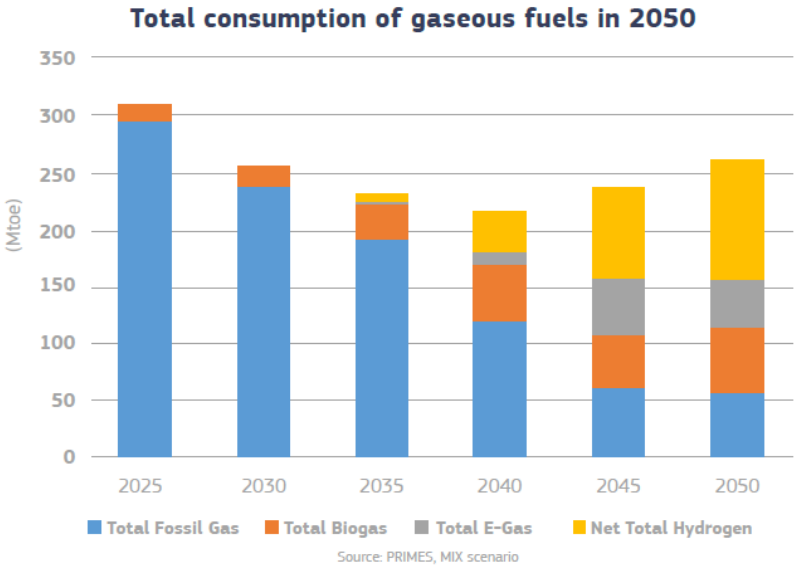
Creating the Hydrogen ecosystem

Hydrogen «ecosystem»

Production | **Distribution**

Hard to electrify sectors
End use technologies

EU COM publication of the *Hydrogen and decarbonised gas markets package*



Technologies & infrastructure: a common pathway towards 2030

270 000 EV
trucks in **2030**

60 000 H2
trucks in **2030**

40-50 000 public charging points > 350 kW

1 000 refuelling stations for HD (700 bar)

40 000 charging points at lower power for public truck stations over highways

200 km max distance over the TEN-T core network

Source: www.acea.auto/trucks

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