Interreg North Sea

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LIHYP

Report 3.2 – Gap analysis regarding green hydrogen economy

Hydrogen Retrofitting of Commercial Vehicles

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1 Introduction

LIHYP project initiates opportunities to accelerate market introduction of hydrogen applications, leading to regional H2 value chains connected in the North Sea Region.

Harmonisation and standardisation as well as incentive policies are essential building blocks for this acceleration. LIHYP's H2 demonstrators (Pilots) provide an opportunity to identify gaps, barriers and the need for regulatory change.

As most of the Pilots involved in LIHYP are conducted on an experimental basis, few regulatory issues have been reported to WP3. This is because experimentation generally allows project leaders to work within a more flexible regulatory framework than that which would normally apply. Nonetheless, these pilots still highlight areas where regulatory frameworks will need to evolve to enable broader, long-term deployment of hydrogen technologies.

Transport is one of the sectors that urgently needs to reduce its emissions. It accounts for almost a quarter of the EU's greenhouse gas emissions and is the main source of urban air pollution. Emissions are still higher than in 1990 and a 90% reduction in total transport emissions is needed by 2050 to achieve climate neutrality. In the medium term, the use of carbon-free or renewable hydrogen could partially decarbonise this sector, especially **heavy-duty transport** (trucks, buses, coaches and inland waterway vessels).

WP3 has therefore decided to build on the experience of the **Normandy retrofitted coach Pilot**, which is particularly advanced as it is commercially operational. In addition to the possibility of experimenting with the use of hydrogen in transport, the fact that it involves the conversion of an existing diesel heavy-duty vehicle into a hydrogen-powered electric heavy-duty vehicle adds a particularly interesting aspect. Indeed, it is well known that replacing diesel vehicles with hydrogen vehicles will remain an economic cost that companies will find difficult to bear for a long time to come.

In the context of building a European hydrogen value chain, **the establishment of an H2 retrofit sector in the EU** may therefore be a relevant solution, both for economic reasons and in terms of sustainable development (circular economy). It appears that such a sector has started to develop in the EU, in particular in some of the countries participating in LIHYP.

However, **the sector is currently at a crossroads**: the technical skills are available and vehicles are starting to be approved. But retrofitters are struggling to find customers and therefore to achieve economic equilibrium. This emerging sector needs to reduce its costs by developing its order book and achieving lower approval costs.

In this context, **hydrogen retrofitting offers a valuable case for examining the policy, legal, and regulatory frameworks that influence market uptake.**

With this in mind, WP3 considered it useful to take stock of the regulatory framework (permitting, incentives) for H2 retrofitting of commercial vehicles in the countries participating in LIHYP and to **identify any regulatory barriers or need for harmonisation of national frameworks**.

This analysis also contributes to broader EU goals—such as those outlined in the Fit for 55 package—by addressing legal and administrative conditions for scaling retrofit solutions. While technical aspects like certification and safety standards are handled at national level, the report identifies opportunities for better alignment and guidance across countries.

1.1 What is Hydrogen Retrofitting?

Hydrogen retrofitting of vehicles consists of:

- either replacing the internal combustion engine (ICE) and fuel tank of a used vehicle by an **electric engin**e + battery (much smaller than that of an electric truck) + a **fuel cell** + hydrogen storage ☞ **Fuel Cell Electric Vehicle (FCEV)**,

- or using hydrogen in an **internal combustion engine** (modification of the original diesel engine or replacement with a new hydrogen combustion engine) + hydrogen storage ☞ **Hydrogen Internal Combustion Engine Vehicle (HICEV)**.

Fuel Cell Electric Vehicle (FCEV)

Hydrogen Internal Combustion Engine Vehicle (HICEV)

The vehicle's entire propulsion system is brand new following the retrofit operation.

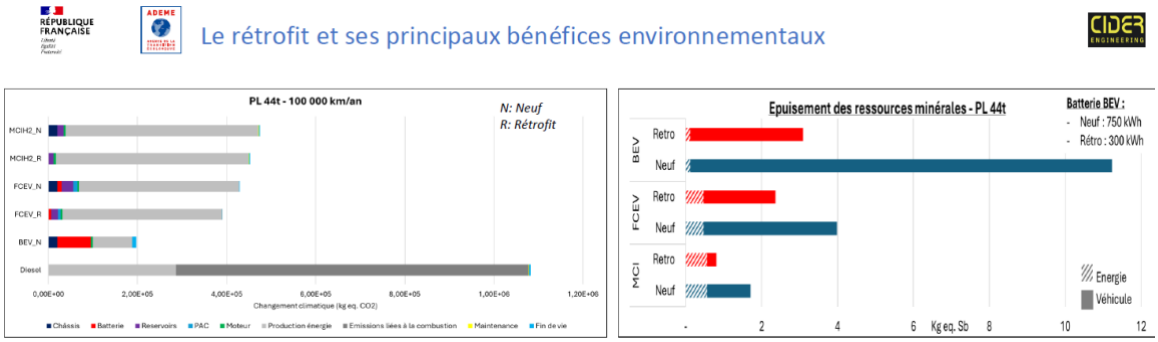
In more general terms, the term retrofit can also refer to activities in which existing engines (e.g. diesel) are modified to accept hydrogen and diesel as fuels (dual-fuel). In such case, hydrogen storage needs to be foreseen within the retrofitted vehicle. Such retrofits are however not primarily in the scope of this report.

1.2 Why Hydrogen Retrofitting?

To decarbonize transport, battery-powered electric vehicles will not be sufficient for the most intensive missions (e.g. >400 km/day and heavy payloads) without oversized batteries (which will reduce payload capacity) or high-power charging infrastructure. H2 retrofitting is an attractive solution for decarbonizing existing commercial vehicle fleets.

1.2.1 Environmental benefits

Retrofitting promotes the circular economy and reduces the need for raw materials by reusing the chassis and extending the service life of the equipment.



Retrofitting and its main environmental benefits, Results for a 44-tonne long-haul tractor

ADEME (French Ecological Transition Agency), CIDER, 2024

ADEME/CIDER study on the environmental assessment of heavy-duty road vehicles indicates that all alternative configurations (BEV[1], FCEV[2], HICEV[3]) result in **a reduction in GHG[4] impacts of more than 50% compared to diesel**. It should be noted that this conversion allows a vehicle to drive in low-emission zones where it was previously prohibited (e.g. in France).

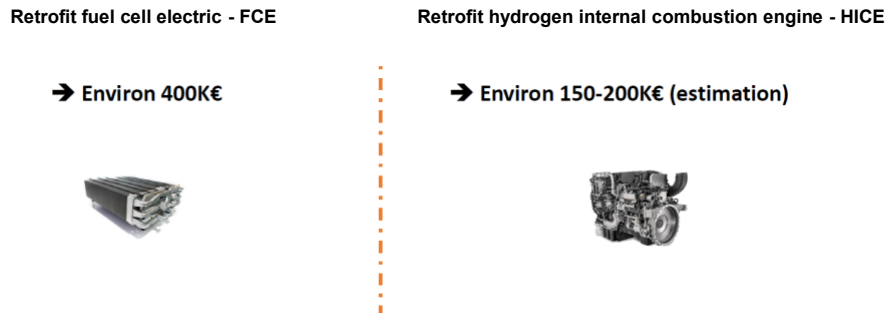
But, in addition, and compared to new vehicles, H2 retrofitting offers the following benefits: a **10% reduction in GHG emissions**, mainly due to savings on the chassis, and **a reduction of around 50% in the quantities of critical metals required** (indicator of mineral resource depletion).

[1] Battery Electric Vehicle
[2] Fuel Cell Electric Vehicle
[3] Hydrogen Internal Combustion Engine Vehicle
[4] Greenhouse gas

1.2.2 Economic benefits

Retrofitting also offers economic benefits :

- Less expensive than purchasing a new zero-emission vehicle,



Source : Richard Lecoupeau, 2C-Consulting[5]

- Accelerates the conversion capacity of diesel vehicle fleets, eliminating the need to wait for replacement or the arrival of offerings from manufacturers,

- Supports reindustrialisation and job creation within regions.

1.2.3 Which vehicles and for what uses?

H2 retrofit offers a real opportunity for transformation for commercial vehicle fleets operating with just-in-time production processes, weight restrictions or topographical constraints:

- **On-road vehicles**:

- 16-to 32-tonne trucks for intensive use,
- 32-to 44-tonne long-haul tractor units,
- Refrigerated trucks (due to their constant power requirements),
- Trucks carrying heavy, energy-intensive equipment,
- Buses and coaches.

[5] EVE webinar, Retrofitting heavy-duty road vehicles: focus on hydrogen propulsion, 13 March 2025 https://www.youtube.com/watch?v=Dye2qOPlyGk

- **Off-road vehicles** : construction and agricultural vehicles, vehicles operating in extreme conditions, and intralogistics, port, airport and railway vehicles, such as excavators, forklifts, container handlers and tractors.

In addition, retrofits are also seen in the maritime and river industries.

2 National regulatory frameworks for H2 retrofitting of vehicles

In LIHYP, each WP3 partner researched the following information for their own country:

- Situation of the H2 retrofit sector: companies carrying out H2 retrofit, retrofitted commercial vehicles approved, bodies responsible for approval, etc.,
- Adoption (or not) of regulations specific to H2 retrofitting of vehicles and their approval,
- Categories of vehicles that can be retrofitted,
- What type of approval is possible for retrofitted vehicles : Do national regulations only allow for individual approval or do they also allow a prototype approval of an H2 retrofit kit for the same family of vehicles?
- International or European technical requirements to be met when converting a vehicle to an H2 configuration,
- Additional national technical requirements or regulatory flexibility
- H2 retrofit incentives policies.

2.1 BELGIUM

2.1.1 H2 retrofitting of heavy duty vehicles in Belgium

In Belgium, there are few but noticeable experiences and projects in retrofitting heavy duty applications, mainly in the area of waste collection trucks, buses, long haul trucks for road vehicles, but also for maritime applications. CMB.Tech and E-Trucks are well known retrofitters in the area of dual fuel (vehicles with diesel engines converted to dual fuel engines (diesel + hydrogen) with hydrogen storage facilities) and hydrogen fuel cells respectively. The total amount of hydrogen retrofitted transport applications that operated on Belgian road and water ways is small and should be less than 10 in total. Although not profoundly part of the transport dimension of the hydrogen strategies on national and regional level, subsidy schemes are available to support retrofitting to hydrogen fuel cell and dual fuel vehicles for road transport.

2.1.1.1 H2 vehicle retrofitting companies

☆ **CMB.Tech** : CMB.Tech (Antwerp, Belgium) converts diesel engines towards dual fuel engines used in heavy duty trucks and ships. It has established a workshop in which it can convert heavy duty road transport vehicles. "*In this workshop, new ICE (Internal Combustion Engine) trucks are converted with CMB.TECH's dual fuel hydrogen technology. In the first phase, CMB.TECH focuses on one type of truck, which enables standardisation. This can significantly reduce the price of the dual fuel conversion. This dual fuel technology can be applied to various brands and it is the first step towards the zero emissions target".* Heavy duty truck fleet owners like Van Moer and Haessaerts are operating truck retrofitted by CMB.Tech. With regards to waterborne applications, the Hydrotug (tug boat) and the Hydroville (ferry) are also equipped with dual fuel engines and operate in the Port of Antwerp-Bruges. Hydrogen refuelling facilities are available in Antwerp (for trucks and boats) and in Oostende (boats).

☆ **E-Trucks** : E-trucks Europe (Westerhoven, Netherlands and Lommel, Belgium) is developing hydrogen waste collection trucks by introducing an electrical driveline with hydrogen fuel cells and storage facilities to waste collection trucks with a stripped diesel driveline. Such a truck is operated by the city of Antwerp. Several similar trucks are operated in the Netherlands as well.

2.1.1.2 Political context

In 2023, a regulatory framework was established to support the further development of retrofitting activities in Belgium. The Belgian Federal government and the Flemish government issued Decrees which should make it easier to homologate retrofitted vehicles with hydrogen and fuel cell systems. The two Decrees complement each other as the Federal Decree (C-2023/30864) sets the technical safety standards for retrofitted vehicles and the Flemish Decree (C-2023/47876) defines the implementation of homologation procedures and regional technical limits. Before issuing these

Decrees, it was a practice that retrofitted vehicles were homologated in the Netherlands and then transferred to Belgium. With these new regulatory frameworks, that should not be necessary anymore.

2.1.2 National authorities

The retrofitting company has to register the retrofitted vehicle online in Flanders in the FASTLANE online system. This system is managed by the Flemish Department of Mobility and Public Works. This department assesses the conformity to the regulations and procedures. Upon a positive assessment, this department provides the final approval.

2.1.3 National regulatory framework for the H2 retrofitting of vehicles

The Federal Public Service Mobility and Transport establishes the technical and administrative requirements that vehicles and components must meet based on European regulations.

On June 1, 2023, the Royal Decree (RD) that allows conversions to vehicles with an electric motor or hydrogen fuel cell entered into force in Belgium. Flanders, in turn, establishes the regional regulations regarding approval and the technical requirements for weights. The Department of Mobility and Public Works verifies whether a vehicle, type, system, component, or technical unit fully complies with these federal technical and administrative requirements. In other words, the approval itself is the responsibility of the regions. On November 10, 2023, the Flemish Government approved the regional regulations, which makes the conversion to an electric motor or hydrogen fuel cell possible in practice.

The Federal Decree adopted by the Federal government is the Royal Decree of 19 April 2023 (C − 2023/30864) amending the Royal Decree of 15 March 1968 laying down general regulations on the technical conditions with which motor vehicles and their trailers, their components and safety accessories must comply, and the Royal Decree of 10 October 1974 laying down general regulations on the technical conditions with which mopeds and motorcycles and their trailers must comply. This Royal Decree of 2023 adds an Article 77 bis to the Royal Decree of 1968. This article 77 bis deals with the conversion of a combustion engine vehicle into an electric vehicle (battery or hydrogen fuel cell).

The Flemish Decree of 10 November 2023 (C − 2023/47876) requires retrofitted vehicles to meet all technical and administrative requirements as established in the Royal Decree of 19 April 2023 covering maximum motor power, safety systems, removal or deactivation of fuel tanks, etc.

The Flemish decree adds constraints on the maximum weight and axle load. After retrofit, the maximum permissible mass must not exceed that of the original vehicle and the weight distribution over front and rear axles must remain within ±10% of the original design.

2.1.4 Retrofit covered by national H2 retrofit regulations

The Royal Decree introduced the technical requirements relating to the conversion of a vehicle with a combustion engine into a vehicle with a **battery-powered electric motor** (BEV) or **hydrogen fuel cell** (FCEV). These technical requirements are applicable to the vehicle, the components and the installation thereof. Retrofits to **dual fuel vehicles** or **hydrogen combustion engine vehicles** are outside of the scope of the Decrees.

2.1.5 Categories of vehicles eligible for H2 retrofit

The vehicles that are covered are vehicle categories: L1e - L7e (powered two-, three- and four-wheelers), M (motor vehicles designed for the carriage of passengers) and N (motor vehicles designed for the carriage of goods). Off road vehicles are not part of the scope of the Decrees.

Category	Vehicle Type	Description	Examples
L1e	Light two-wheel moped	≤ 50cc or electric, max speed ≤ 45 km/h	Electric scooters, 50cc mopeds
L2e	Three-wheel moped	≤ 50cc, max speed ≤ 45 km/h	Piaggio Ape 50
L3e	Motorcycle	> 50cc or speed > 45 km/h	Standard motorcycles
L4e	Motorcycle with sidecar	As L3e, but with sidecar	Classic sidecar bikes
L5e	Tricycle	Three-wheel motor vehicles	Can-Am Spyder, delivery trikes
L6e	Light quadricycle	≤ 425 kg, ≤ 4 kW, ≤ 45 km/h	Renault Twizy 45, small microcars
L7e	Heavy quadricycle	≤ 450 kg (passenger) or ≤ 600 kg (cargo), ≤ 15 kW	Aixam, Ligier, larger microcars
M1	Passenger car	≤ 8 passengers + driver	Cars, taxis, SUVs

M2	Minibus	> 8 passengers, max weight ≤ 5,000 kg	Small buses, passenger vans
M3	Bus/Coach	> 8 passengers, weight > 5,000 kg	City buses, long-distance coaches
N1	Light commercial vehicle	Max weight ≤ 3,500 kg	Delivery vans, small trucks
N2	Medium goods vehicle	Weight between 3,500 kg and 12,000 kg	Medium trucks, cargo transporters
N3	Heavy goods vehicle	Weight > 12,000 kg	Large lorries, freight trucks

There are no restrictions with regards to the vehicle registration date and admission to the road as is the case in France (*see 2.3.6*).

2.1.6 Conditions for the manufacturer of the H2 kit

With regards to the hydrogen systems, it is covered by **EU 2021/535 Annex XIV** (*Hydrogen system material compatibility and fuelling receptacle*).

Technical requirements are described in Section E (*Technical specifications for motor vehicles with regard to their hydrogen system, including material compatibility, fuelling receptacle and vehicle identification*). The installed components of a CHSS (compressed hydrogen storage system), i.e. high pressure container and primary closing devices comprising TPRD (thermal pressure relief device), check valve and automatic shut-off valve, shall be type-approved and marked in accordance with **this Regulation as well as with UN Regulation No 134** (i.e. a double marking is required).

The manufacturer shall ensure that the materials used in hydrogen storage systems are compatible with hydrogen and expected additives and production contaminants and expected temperatures and pressures. This does not apply to materials that do not come in contact with hydrogen in normal condition. Fuelling receptacle requirements for vehicles equipped with CHSS that are complementary to requirements set out in UN Regulation No 134.

2.1.7 Conditions for the H2 retrofit company

In order to become recognised as a retrofitting company, a certificate of Conformity of Production (COP) must be obtained by the retrofitting manufacturers. Only recognized COP manufacturers

can retrofit a vehicle with a combustion engine to a vehicle with an electric motor or hydrogen fuel cell. A non-COP manufacturer who wishes to do such a retrofit needs to contact a COP manufacturer to either execute the retrofit or perform the testing activities required for the homologation of the retrofitted vehicle. In order to become recognised as a COP manufacturer, an audit must be performed by a certified auditor (e.g. Vincotte, TUV Austria, Belgium, LRQA, etc.) to determine its conformity with the regulations. After conversion, the COP manufacturer applies for approval of the retrofitted vehicle at the regional authorities.

Before obtaining a COP certificate, a First Assessment Certificate needs to be obtained. If the certificate is extended after 1 year, it becomes a **certificate of Conformity of Production (COP)**.

The company is required to have at least an ISO 9001:2015 certificate, an equivalent certificate or Compliance Statement according to Regulation (EC) 2018/858. The application procedure that needs to be followed is: Certificaat Conformiteit van Productie | Vlaanderen.be

The installer must demonstrate to the approval authority (the natural person or legal entity who carries out or is responsible for the conversion of the engine) that he has access to all necessary technical documentation of the base vehicle in order to be able to convert the vehicle.

2.1.8 Type-approval and individual approval

Procedures and conditions for approval vary depending on the need for an individual approval or a type-approval. The procedure for applying for a Conformity of Production Certificate differs for manufacturers who manufacture or modify a vehicle or component on a one-time basis, or for serial production.

2.1.8.1 Conformity of Production if you produce a single or occasional piece

2.1.8.1.1 Step 1: Submit the application form

Log in via Fastlane (opens in a new window), open a file, and provide information regarding your application, the "Initial Assessment_COP" application form, the ISO certificate and accompanying audit report, materials overview, competency matrix of the organization and checklist(s)

2.1.8.1.2 Step 2: Demonstrate the quality of your production process

If you already have an ISO 9001:2015 certificate, an equivalent certificate, or a Compliance Statement according to Regulation (EC) 2018/858, then the following matters will be checked, both administratively and on-site: traceability, legislative follow-up, equipment and measuring instruments, follow-up of assembly guidelines, files via a sample from Fastlane, competence matrix

and execution of those tasks follow-up comments from the Homologation Unit during previous inspections, plans, technical drawings, workshop instructions, and checklists.
If you do not have an ISO 9001:2015 certificate, equivalent certificate, or Compliance Statement according to Regulation (EC) 2018/858, the assessment will be carried out by a category D technical service, appointed by the approval authority to inspect or test production samples or to supervise inspections and tests.

2.1.8.1.3 Step 3: Receive the certificate and regain access to BEVASYS and Fastlane.

When there are issues, the Homologation Unit will agree on when everything should be in order. Is your application in order, or are there only a few points that need improvement? You will then receive the Audit report, the Certificate of Conformity of Production, an Extension of your access to Fastlane and

2.1.8.2 Conformity of Production if you produce in series

The following information needs to be provided: description of the application, the application form 'Initial Assessment_COP' (Form can be found in the Fastlane application), the ISO certificate with accompanying audit report, the overview of materials, competency matrix of the organization and checklist(s).

The further process varies depending on whether you, as a manufacturer, only require type approvals or also individual approvals.

Do you have an ISO certificate and only apply for type approvals? Then a category D technical service will conduct the inspection.

Do you have an ISO certificate and are you applying for both individual and type approvals? The audit is then carried out by the technical service for categories C and D.

Inspections by the technical service for category C: traceability, legislative follow-up, equipment and measuring instruments, follow-up of assembly guidelines, files via a sample from Fastlane, competency matrix and performance of these tasks, follow-up comments from the Approval Unit during previous inspections, plans, technical drawings, workshop instructions, and checklists.

Inspection by the technical service for category D: Production control follow-up. The technical service submits the audit report to the Approval and Technical Inspection Unit of the Department of Mobility and Public Works. You will receive an Audit report, Certificate of Conformity of Production and Extension of your access to Fastlane.

2.1.9 International or European technical requirements to be met for H2 conversion

The technical requirements that the retrofitted vehicle must fulfill to are listed in the table below

Number	Subject	Regulation	Note
1A	Sound level of vehicle and replacement sound reduction system	EU 540/2014 & UN/ECE R138	C
2A	Power	UN/ECE R85	C
2A	Emissions	EU 715/2007 & 2017/1151	C
5A	Steering device	UN/ECE R79	B
9A, 9B	Braking system	UN/ECE R13 or R13H	A
10A	Electromagnetic compatibility	UN/ECE R10.05	A/C**
13B	Security against unlawful use	UN/ECE R116	C
17A, 17B	Speedometer & reversing device	UN/ECE R39 & EU 130/2012	C
18A	Construction plate	EU 2021/535 Annex II	B
20A	Installation of lighting and light signalling devices	UN/ECE R48	C
33A	Placement & identification of control systems	UN/ECE R121	C
34A	Defrosting and demisting systems	EU 2019/2144	C
36A	Heating system	UN/ECE R122	A*/C**
42A	Side protection	UN/ECE R73	B
44A, 48A	Dimensions	EU 2021/535 Annex XIII	B
47A	Speed limiter	UN/ECE R89	A
62	Hydrogen systems	EU 2021/535 Annex XIV	A
69	Safety of electrical materials	UN/ECE R100.01	A

Notes:

A: Unless otherwise stated, all requirements of the regulations must be met; the tests and checks must be carried out by an approved technical service; a test report must be drawn up.

B: Regardless of any transitional provisions, only the technical requirements of the regulations need be met; the tests and checks must be carried out by the manufacturer himself or by an approved technical service; a test report must be drawn up.

C: Regardless of any transitional provisions, only the technical requirements of the regulations need to be met; the tests and checks must be carried out by the manufacturer himself or by an approved technical service; a declaration of conformity submitted by the manufacturer is sufficient. No test report is required.

*: Component
**: Installation

A small note with regards to the scope of the regulations applicable:

- **EU 540/2014** – Limits the exterior noise of motor vehicles and replacement silencing systems; requires electric/hybrid vehicles to be fitted with Acoustic Vehicle Alerting Systems (AVAS) for pedestrian safety below ~20 km/h; in force since July 2016
- **EU 715/2007** – Sets Euro 5 and Euro 6 emissions standards for light vehicles, bans defeat devices, mandates type-approval, repair information access and proportionate penalties for non-compliance.
- **EU 2017/1151** – Supplements 715/2007 by introducing Real Driving Emissions (RDE) and WLTP testing procedures to ensure more realistic emission measurements
- **EU 130/2012** – Typically related to heavy-duty vehicle CO_2 labelling or related certification; confirms conformity mechanisms (less prominent in summaries).
- **EU 2019/2144** – Introduces mandatory safety features (e.g. AEB, lane-keep, blind-spot, pedestrian detection, event data recorders); aligns multiple UN/ECE R-Regulations into EU Annexes (Annex II, XIII, XIV, etc.)
- **EU 2021/535** – Delegated regulation amending Annex II, XIII, XIV: updates listing of applicable UN/ECE regulations for safety—and environmental—for vehicle type-approval under EU law.
- **R138** – Approval of silent road transport vehicles (e-vehicles): tests and standards for AVAS sounds at low speeds (up to ~20 km/h) to compensate lack of engine noise.
- **R85** – Net power measurement standard and max 30-minute power output for electric powertrains.
- **R79** – Steering equipment requirements.

- **R13** – Service braking systems for trucks and buses; **R13H** – Passenger-car braking systems, both defining performance and test criteria
- **R10 (often R10-05)** – Electromagnetic compatibility (EMC) for vehicle electronics and subassemblies; E-mark certification scheme
- **R116** – Anti-theft (immobiliser) requirements for motor vehicles.
- **R39** – Speedometer functionality and accuracy.
- **R48** – Installation of lighting and signalling devices (layout, visibility).
- **R121** – Sets standards for how dashboard controls and displays (e.g. buttons, warning lights, knobs) should be identified, located, and designed, so drivers can understand and use them easily and safely.
- **R122** – Lane-change and blind-spot information systems (BSIS).
- **R73** – Lateral protection devices (side underrun guards on trucks).
- **R89** – Speed limiter (mandatory speed-limiting devices for certain vehicle categories).
- **R100.01** – Safety, functional, hydrogen emission, and battery requirements for electric vehicles and fuel-cell vehicles (so-called “EV regulatory package”).

2.1.10 Additional national technical requirements for H2 conversion

The Roydal Decree (C − 2023/30864) stipulates the following requirements and (international) regulations to be followed:

- The **fuel tanks** of the vehicle undergoing conversion must be removed or rendered unusable.
- The **net power of the engine** of the vehicle that has been converted must be within the closed range of 65%-100% of the maximum net power of the original engine.

By way of derogation, if the conversion involves a vehicle with an original engine with a maximum net power of 60 kW or less, the maximum net power of that vehicle may be increased by **up to 20%**.

The range for small engines in vehicles in categories M and N (<=60 kW) has been extended to 65-120% (deviating from the standard closed range of 65% to 100% of the maximum net power described in this article), so that some older vehicles are more likely to find a replacement electric motor, given that it is difficult to find an electric motor with such a low maximum net power.

2.1.10.1 Possible changes to the Dimensions of the vehicle

The Flemish decree (C − 2023/47876) highllights that the dimensions of the base vehicle undergoing conversion must not be altered by the conversion.

2.1.10.2 Possible changes to the Mass of the vehicle

- the technically permissible maximum mass of the vehicle, the technically permissible maximum mass of the combination of vehicles and the technically permissible maximum mass on each axle **are not increased** in relation to the base vehicle;
- the distribution between the mass in running order and the actual mass after conversion **does not deviate by more than 10%** from the distribution between the mass in running order and the actual mass of the base vehicle.

With regards to mass, the technically permissible maximum mass of the vehicle, the technically permissible maximum mass of the vehicle combination and the technically permissible maximum mass on each axle can not be raised in comparison to the base vehicle. The mass distribution of the may deviate not more than 10% from the mass distribution of the base vehicle

2.1.11 Information for customers

Customers wishing to retrofit their vehicle need to have that conversion done or tested by an COP organisation. Once the customer receives the homologated vehicle, it has to go through periodic inspections like any vehicle: if the vehicle is less than 8 years old or has a maximum total milage of 160.000 km, then it needs to be checked every 2 years, otherwise, every year.

2.1.12 H2 retrofit incentive policies in Belgium

2.1.12.1 Ecologiepremie+ in Flanders

The Ecologiepremie+ provides a financial incentive to support the retrofit of existing vehicle to hydrogen:

- retrofit to a driveline with hydrogen fuel cells
- retrofit to a dual fuel driveline with hydrogen (typically conversion of a diesel engine to a dual fuel (diesel-hydrogen engine)

The vehicles that fall within the scope of the subsidy scheme are :

(a) light commercial vehicles: a clean vehicle as defined in point 4(a) of Article 4 of Directive 2009/33/EC of the European Parliament and of the Council (vehicles types: M1, M2 or N1);

(b) heavy-duty vehicles:

- until 31 December 2025, a low-emission heavy-duty vehicle as defined in point 12 of Article 3 of Regulation (EU) 2019/1242 of the European Parliament and of the Council (vehicles >3,5T);
- until 31 December 2025, a clean vehicle as defined in point 4(b) of Article 4 of Directive 2009/33/EC not covered by Regulation (EU) 2019/1242 (vehicles types: M3, N2 or N3);

Off-road vehicles are included as well. The maximum number of vehicles that can be support per organisation is two. There is also no maximum support level per vehicle.

The eligible costs are 100% of the additional costs with a net subsidy percentage of:

- for hydrogen fuel cell retrofits: 50% for SMEs and 30% for non-SMEs.
- for dual fuel retrofits: 30% for SMEs and 15% for non-SMEs.

So retrofits to 100% hydrogen internal combustion engines do not fall within the scope of the Ecologiepremie+ subsidy programme.

2.2 DENMARK

2.2.1 H2 retrofitting of duty vehicles in Denmark

In Denmark, the retrofitting of light and heavy commercial vehicles (trucks, vans, buses, coaches, refuse collection vehicles, etc.) to hydrogen technology is emerging as part of the country's broader green transition strategy. However, regulatory measures and type-approval processes are still evolving.

There are no specific companies that are specialising exclusively in H2 retrofitting of vehicles in Denmark. There are other organisations that contribute to the H2 ecosystem e.g Hydrogen Refueling Stations (HRS). Everfuel and NEL ASA are both engaged in establishing HRS in Denmark and the government has come up with a plan for four HRS for now, with plans to increase the numbers in the future.

As seen in the picture, Aalborg, Aarhus, Odense and Copenhagen are the chosen cities for HRS that will fulfill the requirements in the AFIR.

2.2.2 National regulatory framework for the H2 retrofitting of vehicles

Currently, Denmark does not have a dedicated regulatory framework exclusively addressing the hydrogen retrofit of commercial vehicles. Instead, existing vehicle approval processes and environmental regulations set the conditions for such conversions. The approval process follows EU directives and Danish Transport Authority guidelines, particularly in compliance with:

- **The Danish Road Traffic Act (Færdselsloven)** – Covers general vehicle approval and modifications.
- **Regulation (EU) 2019/2144** – Sets safety requirements for hydrogen systems in vehicles.
- **UN/ECE Regulation No. 134** – Defines technical standards for hydrogen-powered vehicles.

Similar to other EU Member States, Danish authorities require type-approval or individual approval of retrofitted vehicles, depending on their category and use.

2.2.3 Conversion devices covered by national retrofit regulations

While there is no specific Danish regulation governing hydrogen conversion kits, they must meet international safety and technical standards, including:

- Compliance with UN/ECE regulations on hydrogen storage and fuel cell safety.
- Technical inspection and approval by the **Danish Road Safety Agency (Færdselsstyrelsen)**.
- Adherence to existing emission control regulations set by the **Danish Environmental Protection Agency (Miljøstyrelsen)**.

2.2.4 Type-approval and individual approval

In Denmark, vehicle modifications require either:

1. **Type-approval** – Applies to mass-produced retrofit kits installed on a series of vehicles.
2. **Individual approval (*Enkeltgodkendelse*)** – Required for unique vehicle retrofits, such as pilot projects.

As of 2025, several pilot projects, such as hydrogen-powered buses in Copenhagen and Aarhus, have undergone individual approval procedures.

2.2.5 Categories of vehicles eligible for H2 retrofit

Danish authorities allow hydrogen retrofits for multiple vehicle categories:

- Passenger transport vehicles (category M)
- Goods transport vehicles (category N)

- Refuse collection and municipal service vehicles

Denmark does not impose a minimum vehicle age for hydrogen retrofits. This contrasts with France, where the retrofit decree requires vehicles to be at least 5 years old (2 years for L-category vehicles). In Denmark, the decisive factor is **roadworthiness and compliance with saftety standards**, not age.

2.2.6 Conditions for manufacturers and retrofit companies

Retrofit companies must demonstrate compliance with EU and UN/ECE technical standards to the Danish Road Safety Agency (Færdelsstyrelsen).
Workshops must comply with general Danish occupational safety and environmental rules (handled by the labor inspectorate (Arbejdstilsynet).
Workshops performing retrofits should meet ISO 26262 safety standards for vehicle modifications.As it is not a legal requirement in Denmark.

2.2.7 International or European technical requirements to be met for H2 conversion

Denmark follows EU and UN/ECE technical requirements for hydrogen vehicle safety.

2.2.8 Additional national technical requirements for H2 conversion

Additional national specifications include:

◆ Vehicle weight limits: Modifications must not exceed original manufacturer weight restrictions without additional approval.

◆ Crash safety compliance: Converted vehicles must pass Danish crash test standards if structural modifications are made.

◆ Electromagnetic compatibility (EMC) testing: Ensures that hydrogen retrofit systems do not interfere with vehicle electronics.

2.2.9 H2 Retrofit incentive policies in Denmark

To encourage hydrogen vehicle retrofits, Denmark provides several incentives:

2.2.9.1 Green tax exemptions

Hydrogen-powered vehicles benefit from reduced registration taxes. This is outlined in the Danish government's taxation scheme for zero emission cars, which includes a prolonged and complete tax exemption for fuel cell electric vehicles (FCEVs) until 2022.

2.2.9.2 Government grants

Funding is available through programs like the **Green Transport Initiative (Grøn Transportpulje)**, which supports the development of hydrogen infrastructure and vehicle adoption.

2.2.9.3 Public procurement policies

Municipalities prioritize zero-emission retrofitted vehicles in fleet renewals, aligning with national environmental goals.

2.2.10 Challenges and recommendations

Regulatory harmonization: Denmark faces challenges with cross-border hydrogen vehicle approvals due to differences in national regulations. A common EU-framework would facilitate seamless retrofits.

◆ Lack of a unified EU framework :

- **Problem**: The European Union does not currently have a harmonized regulatory framework specifically for hydrogen retrofitting of vehicles ;
- **Impact on Denmark**: Danish authorities rely on general EU type-approval regulations (e.g. Regulation (EU) 2019/2144 and UN/ECE Regulation 134), but the absence of EU-level - specific legislation leads to inconsistencies ;
- **Result**: A hydrogen-retrofitted vehicle approved in one EU country may **not automatically be accepted** in another due to differing interpretations, administrative procedures, and technical testing requirements.

◆ Different national standards and approval processes :

- **Problem**: Each EU member state may impose **additional national technical requirements**, such as limits on weight changes, specific emission standards, or structural modifications.
    - **Example**: A vehicle retrofitted in the Netherlands may be allowed to carry more hydrogen weight than in Denmark. If that vehicle is then imported into Denmark, it may require **re-approval** or modification.

- **For Denmark**: This increases administrative burden and delays for retrofit companies aiming to serve a broader European market. It can discourage companies from scaling operations or pursuing exports.

◆ Fragmented type approval systems :

- Denmark permits both:
  - **Type-approval** (for a series of vehicles using a standardized kit)
  - **Individual approval** (Enkeltgodkendelse, used mostly in pilot projects)

- Other countries may **not recognize individual approvals** from Denmark or may require further inspections

- For companies, this means **extra cost, time, and engineering effort** to comply with varying approval systems

◆ Unclear Recognition of retrofits across borders :

- A hydrogen-retrofitted truck approved in Denmark under individual approval may **not be recognized** in Germany or France, especially if their frameworks demand type-approval only ;

- **Logistical difficulty** arises when vehicles are intended for international operations (e.g., cross-border freight transport), but can't be freely operated in neighboring countries.

◆ Difficulties faced by retrofit companies in Denmark :

- Small domestic market size : Denmark´s relatively small fleet of commercial vehicles limits domestic demand, making **cross border sales essential** for business viability. The current lack of harmonisation restricts this potential ;

- Cost of multiple approvals : Danish retrofitters may have to **obtain separate approvals** for each EU country they wish to operate in, raising costs significantly and creating entry barriers ;

- Limited guidance and national regulations : Denmark lacks specific national legislation dedicated to H2 retrofits. This leaves companies to **navigate vague rules** or adapt existing ones meant for conventional modifications ;

- Inconsistent weight and safety Requirements : vehicle mass, axle load, crash safety, and hydrogen system layout requirements may vary between countries. This results in **design complexity** and retrofit kits that need to be adapted per market.

◆ Infrastructure Development: The Danish hydrogen refueling network is expanding, but availability remains limited compared to traditional fuels.

◆ Standardization of Approval Processes: clearer national guidelines on hydrogen retrofits would support industry growth and ensure compliance. Danish retrofit companies are hindered by the absence of a harmonized EU framework, inconsistent approval rules between countries, and vague or incomplete national guidance. These issues cause delays, raise costs, and reduce market access, making it harder for Denmark's hydrogen retrofit industry to scale or compete internationally.

2.2.11 Sources

- *Danish Road Safety Agency (Færdselsstyrelsen) – Vehicle approval regulations*
- *Danish Environmental Protection Agency (Miljøstyrelsen) – Emission standards*
- *EU Regulation 2019/2144 – Hydrogen vehicle safety rules*
- *UN/ECE Regulation 134 – Fuel cell and hydrogen storage safety*

2.3 FRANCE

2.3.1 H2 retrofitting of duty vehicles in France

Faced with a low supply of new hydrogen-powered commercial vehicles (trucks and coaches), **a few French companies** have embarked on the H2 retrofitting of existing vehicles. However, their activity is still in its infancy. They are finding it **difficult to achieve economic equilibrium** and are experiencing financial difficulties.

They give priority to the approval of conversion kits for **vehicle types with a high volume of vehicles in circulation**, such as the IVECO CROSSWAY in the coach segment.

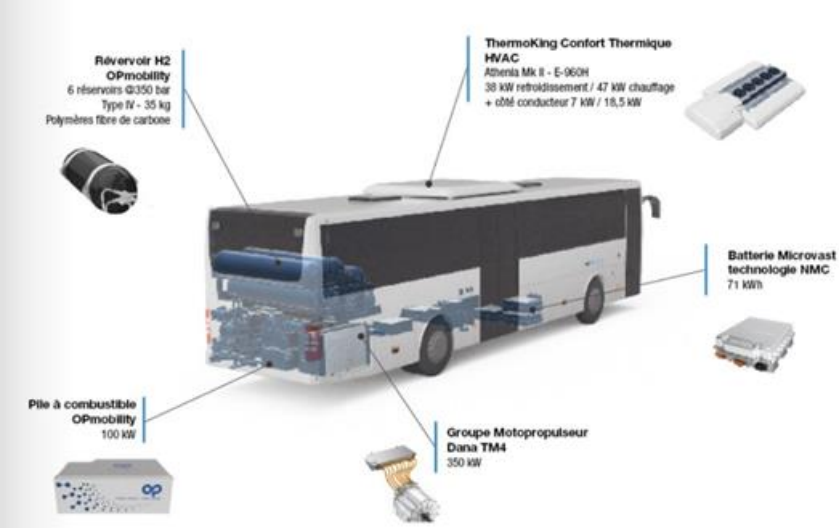
The H2 retrofit sector needs massive, structuring deployment projects to scale up. In France, the **coach fleets** operating on the public transport networks are mainly owned by **public authorities** (*Autorités organisatrices de la mobilité* - AOM). It is therefore these public authorities (municipalities, groups of municipalities, départements, regions) that will dictate the development of the retrofit sector through **public procurement**.

The situation is different when it comes to H2 retrofitting **trucks**, which are owned by **private operators**. Solutions will have to be found to enable them to recover their costs (public subsidies, pay-per-use contracts, etc.).

2.3.1.1 H2 vehicle retrofitting companies

⭐ **E-NÉO**, a pioneer in the H2 conversion of **heavy-duty vehicles** in France, **went into judicial liquidation in 2023**, but was acquired by VENSYS group which specialises in the traction of agricultural and construction machinery. However, it no longer seems to be very active in this market.

⭐ **SAFRA** is a manufacturer of hydrogen-powered buses under the **HYCITY** brand, launched in 2022. It offers hydrogen **conversion of diesel coaches with its H2-PACK® kit**, which was approved in March 2024 thanks to public funding (*France 2030 investment plan*). This kit allows H2 retrofit of the **MERCEDES-BENZ INTOURO** model (350 kW engine, 2 fuel cells of 35 kW each, 6 tanks located in a space gained above the original passenger compartment, 35 kg of H2 at 350 bar, 71 kWh battery pack). SAFRA supplied H2 converted MERCEDES-BENZ INTOURO coaches to the Occitanie Regional Council in 2024. However, **SAFRA went into receivership in February 2025**.



Components of the SAFRA H2-PACK® kit come mainly from French companies.

⭐ Since 2024, **HYLIKO** has been offering a rental service for **two converted H2 lorries**, for which it received approval in 2024. These vehicles are rented out to the company POINT P (sale of building materials).

HYLIKO Hy T44 First Edition & HYLIKO R26 First Edition

☛ The **HYLIKO Hy T44 First Edition** is a 44-tonne **tractor** based on a RENAULT TRUCKS T 520 4x2 diesel model. It has two 80 kW fuel cells, giving a total of 160 kW. These are supplied by TOYOTA and supplemented by two 60 kWh battery packs from French manufacturer FORSEE POWER. Seven hydrogen tanks are located behind the cab. Supplied by OPmobility, formerly PLASTIC OMNIUM, they can hold up to 40.8 kilos of hydrogen at 350 bar. Hyliko claims a range of more than 450 km on a full tank,

☛ The **HYLIKO R26 First Edition** is a 26-32t crane carrier truck based on a 480 hp RENAULT TRUCKS C-range 6x4 26T or 6x2 26t model released in 2018.

In order to eliminate the still very high acquisition costs, HYLIKO has opted for a **pay-per-use system**[6] with contracts that are invoiced per kilometre driven. If a haulier wants to convert his truck, HYLIKO buys it back, converts it and makes it available again on a rental basis. If the haulier does not have any RENAULT TRUCKS in its fleet, HYLIKO can search the second-hand market to find a vehicle that meets its needs.

In September 2023, **HYLIKO** announced its association with **SAFRA** to acquire an industrial production capacity of a few dozen vehicles per year from 2024, increasing to a few hundred vehicles per year. To this end, HYLIKO undertook to supply diesel-powered heavy goods vehicles to SAFRA's factories in Albi (Tarn). The vehicles were to be retrofitted with a hydrogen-hybrid powertrain developed by SAFRA. However, **SAFRA went into receivership in February 2025**.

✯ **CGK Group** seems to be the only French retrofit company that has managed to make a success of itself. It works with several specialist manufacturers (IVECO, RENAULT) as well as its sister companies (GCK Battery, GCK Performance, Solution F) **to develop kits for a wide range of models**.

GCK has received type approval for an H2 kit for three variants of the **IVECO CROSSWAY Euro VI**:

- IVECO CROSSWAY NF 80 (2024)
- IVECO CROSSWAY NORMAL FLOOR SP150 (2025) (the most common in France)
- IVECO CROSSWAY LOW ENTRY 75 (2025)

An approval procedure is underway for the IVECO CROSSWAY NF HICE variant.

[6] Or ‘pay-as-you-drive leasing model’

IVECO CROSSWAY NORMAL FLOOR 150 & IVECO CROSSWAY LOW ENTRY 75

GCK has an **industrial site** in Cournon-d'Auvergne (Rhône Alpes Region).

It is listed in the **UGAP catalogue** (*Union des Groupements d'Achats Publics* : a public purchasing centre) as a provider of vehicle retrofitting services, which facilitates its access to the public fleet market, where there is an obligation to purchase very low emission vehicles when renewing fleets. In this context, and from 2021 onwards, public authorities can fulfil their obligation by purchasing H2 retrofitted vehicles or by having existing vehicles retrofitted.

The **Auvergne-Rhône-Alpes Regional Council** has ordered 50 H2 retrofitted coaches from GCK. The first 16 vehicles will be delivered between March and June 2025 to the three transport companies operating routes for the Regional Council. These coaches will be used in cities such as Lyon, Grenoble and Annecy.

Delivery of the first GCK retrofitted H2 coach to the the Auvergne-Rhône-Alpes Regional Council in March 2025

Other French municipalities or groups of municipalities are also testing converted H2 coaches supplied by GCK.

At the end of January 2024, **GCK and Keolis** announced a partnership to test an IVECO CROSSWAY bus with a Cursor 9 diesel engine converted to run on hydrogen. The vehicle will be tested in the first quarter of 2025 before being submitted for approval.

GCK also offers H2 conversion for **specialised vehicles**:
- **Waste collection trucks** : retrofitting of 2 vehicles ordered by Grand Paris Sud Est Avenir (a group of municipalities) in January 2025 (17 kg of hydrogen on each vehicle),
- **Hooklift trucks** (hydraulic lifting arm system with hook),
- **Concrete mixers**.

For heavy-duty vehicles, GCK is focusing on **long-haul tractors** with hydrogen internal combustion engines (HICE). The electric-hydrogen solution (fuel cell) is not possible for long-distance operation: 180 kW battery not industrially available, H2 storage problem, conversion costs.

⭐ **EHM (Efficient Hydrogen Motors)** is working on a **hydrogen combustion engine which replaces the diesel combustion engine**. It has signed a partnership with **TRANSDEV** to convert an IVECO CROSSWAY diesel coach into a coach equipped with a high-efficiency hydrogen combustion engine. Its power output is 265 kW. Hydrogen consumption is estimated at 6 kg/100 km. This project is funded by the European Regional Development Fund (ERDF). The coach comes from the Transdev Bretagne fleet. It should be in service on a regular route in 2025.

⭐ **Retrofit Hydrogene RH2** proposes **modifying the original engine to convert it into a hydrogen combustion engine**. The solution developed by RH2 is based on direct injections of hydrogen and atomised water into the cylinder head. An extensive thermodynamic study was conducted to identify the best scenarios while retaining the original mechanics, including the liners and pistons. The result is a retrofit solution at a competitive price.

2.3.1.2 Political context

In France, the retrofitting sector is being organised with the creation of the **Coalition Rétrofit H2** (28 members and 17 partners) which aims to create a network of retrofitters and maintenance workshops, attract industrial investment of 30 to 50 million euros, reduce costs by massifying volumes (target: retrofitting 10,000 lorries/year in France in 2030), promote orders for retrofitted lorries by committed hauliers followed by their shippers, and mobilise the public authorities to adapt regulations and taxes and provide subsidies.

At a time when **structuring programme documents are being finalised in France** (3rd *Multiannual Energy Planning* -PPE3-, 3rd *National Low Carbon Strategy* - SNBC3-, revision of the *National Strategy for Carbon-Free Hydrogen in France*), representatives of the hydrogen and hydrogen retrofitting sector have asked the French government to take a position on heavy duty hydrogen powered road transport (March 2025).

The French ***National strategy for carbon-free hydrogen 2025*** (published on 16 April 2025) notes that a downstream sector for hydrogen mobility has developed in France, particularly with **retrofit players**. It states that while the electrification of applications is the preferred means of decarbonising road mobility, for certain specific applications requiring a long range over the course of the day, high availability, fast recharging time, maintaining payload or even greater energy requirements (temperature changes, altitude differences), **hydrogen could become relevant, even if it is currently more expensive. In particular, these are activities with intensive energy**

requirements or difficult access to electricity, such as certain heavy vehicles, vehicles with on-board energy requirements (e.g. refrigeration), construction machinery, agricultural or off-road machinery, areas where long range is required. It concludes that the relative place of hydrogen in these segments will become clearer as the decarbonisation of transport progresses.

2.3.2 National authorities

CNRV (*Centre national de réceptions des véhicules*) is a national public service attached to the Vehicle Safety and Emissions Sub-Directorate (SD6) of the Directorate-General for Energy and Climate (DGEC). It is the national authority that issues the « prototype approval », i.e. the approval or certification of a vehicle type equipped with a battery or fuel cell electric conversion device. This is done at the request of the H2 kit manufacturer ;
UTAC (*Union technique de l'automobile, du motocycle et du cycle*) is the laboratory designated to carry out technical tests on converted vehicles and to establish the compliance of vehicles and their equipment with the directives issued by the European Commission.

2.3.3 National regulatory framework for the H2 retrofit of vehicles

France has been a pioneer in adopting in 2020 a regulatory framework specifically dedicated to electric or hydrogen retrofitting.

- ***Decree of 13 March 2020*** *on the conditions for converting vehicles with internal combustion engines to battery electric or fuel cell engines (**H2 retrofit decree 2020**).*
  This decree defines the conditions for the type-approval and installation of **devices for converting vehicles** with internal combustion engines to battery (BEV) or fuel cell electric drive (FCEV). It was amended in 2023 to take account of feedback from experience

- ***Decree of 19 July 1954*** *on the approval of motor vehicles (**Approval of motor vehicles decree 1954**).*
  This decree generally concerns **type or individual approval**. In particular, it applies to the approval of vehicles where the combustion engine is replaced by a hydrogen internal combustion engine (HICEV).

2.3.4 Conversion device covered by national H2 retrofit regulations

The ***H2 retrofit decree 2020*** defines the conditions for the type-approval and installation of devices for converting vehicles with internal combustion engines to **battery (full EV conversion) or fuel**

cell electric motor (BEV or FCEV)**.** These devices are called « **electrical conversion device** » (« *dispositif de conversion électrique* »).

The device for converting vehicules to FCEV is more commonly known as a "*H2 conversion kit*" or "*H2 kit*".
It comprises at least :
- a **drive unit** (electric machine and associated power converter) mounted upstream of the transmission elements;
- a **battery pack** designed to supply energy and traction power exclusively;
- an interface with the mains to charge the battery pack;
- where applicable, an energy converter transforming chemical energy (input energy) into electrical energy (output energy) or vice versa (**fuel cell**);
- where applicable, the **hydrogen tank** and all other parts of the hydrogen-powered vehicle which are in direct contact with hydrogen or which form part of a hydrogen system within the meaning of Regulation EC 79/2009[7] ;
- any other sub-system required for the proper operation of the converted vehicle (*H2 retrofit decree 2020, art. 2, 4°*).

The hydrogen system can be designed to use **gaseous or liquid hydrogen**.

The *H2 retrofit decree 2020* does not cover **hybrid** add on system with remaining ICE engine.

The replacement of the combustion engine by a **hydrogen internal combustion engine** (HICE) is not covered by the *H2 retrofit decree 2020*. Such a conversion is subject to the provisions of the *Approval of motor vehicles decree 1954*. To date, **no HICE retrofit offer has yet been approved in France.**

The *Approval of motor vehicles decree 1954* was amended in 2023 to exempt the technical advice of the manufacturer (of the unmodified vehicle type) when this conversion (HICE) concerns a vehicle **more than 5 years old**.

[7] Regulation (EC) No 79/2009 on the type-approval of hydrogen-powered motor vehicles was repealed as of 6 July 2022 by Regulation (EU) 2019/2144 on the requirements for the type-approval of motor vehicles and their trailers, supplemented by Commission Implementing Regulation (EU) 2021/535 laying down rules for the application of Regulation (EU) 2019/2144 as regards uniform procedures and technical specifications for the type-approval of vehicles, and of systems, components and separate technical units intended for such vehicles, as regards their general construction characteristics and safety (Annex XIV : Hydrogen system material compatibility and fuelling receptacle)

2.3.5 Type-approval and Individual approval

The type-approval of vehicles converted with a H2 conversion kit must be compatible with the vehicle type-approval requirements in accordance with Directive 2007/46/EC or Regulation EU 2018/858 and Regulation EU 168/2013 respectively according to categories M, N or L, or to the decree of 19 July 1954, in particular their safety requirements (*H2 retrofit decree 2020, art. 3, 3°*).

In France, the *H2 retrofit decree 2020* only deals with "prototype approval" (*type approva*l), i.e. the approval of a hydrogen kit that can be installed on the same family of vehicles (vehicles of a particular category that are identical in at least their essential aspects). Type approval enables the process to be industrialised and other vehicles of the same family to be retrofitted, thereby reducing the cost of the retrofit.

However, *the 1954 decree* also allows the approval of a single H2 retrofitted vehicle ("*réception à titre isolé* - RTI" or " individual approval "). This was the case for the CROSSWAY IVECO EURO 5 coach operated by TRANSDEV in 2024 (French pilot).

In 2024, a retrofit company (GCK) obtained a prototype approval for this same family of coaches (CROSSWAY IVECO), but only for EURO 6.

2.3.6 Categories of vehicles eligible for H2 retrofit

In France, the *H2 retrofit decree 2020* allows H2 retrofitting of all vehicles for the transport of persons (category M) or goods (category N) with at least 4 wheels, as well as two- or three-wheeled motor vehicles and motor quadricycles (category L).

The *H2 retrofit decree 2020* was amended in 2023 to allow the retrofitting of a **wider range of vehicles:**

- specialised vehicles, i.e. vehicles intended for a function that requires special equipment. Ex: waste collection trucks, camper vans, wheelchair accessible vehicles, mobile cranes, etc.,
- specialised recovery vehicles: tow trucks.

➢ **To convert a vehicle in a FCEV[8]**, the technical opinion of the manufacturer of the unmodified vehicle type is not required (*Approval of motor vehicles decree 1954, art. 12 ter, 5°*).

[8] Fuel Cell Electric Vehicle

However, the vehicle must have been **registered in a definitive series (≠ provisional) for at least 5 years** from the date of conversion (2 years for category L vehicles). This 5-year period may be waived in the event of **technical approval** from the vehicle type manufacturer (*H2 retrofit decree 2020, art. 2, 1°, c and art. 3, 1°*).

➢ **To convert a vehicle in a HICEV**[9], the technical approval of the manufacturer of the non-converted vehicle type must be obtained, **unless the date of first registration is at least 5 years** prior to the date of conversion (*Approval of motor vehicles decree 1954, art. 12 ter*).

However, whether it is a conversion to FCEV or a conversion to HICEV, the *Approval of motor vehicles decree 1954* states that any defect or malfunction caused directly or indirectly by the conversion **is not covered by the original manufacturer's legal or commercial warranty in any way**. The H2 retrofit company is therefore obliged to guarantee the preservation of the integrity of all the elements of the converted vehicle on which the conversion is carried out, and is responsible for any deterioration of the other elements of the vehicle that have not been converted.

2.3.7 Conditions for the manufacturer of the H2 kit

The **'Manufacturer'** (*fabricant* or *constructeur*) **is** the person or body which, regardless of their position in the production or marketing process, applies for type approval and undertakes to be responsible for all aspects of the type approval process and the conformity of production (*Highway Code, art. R. 321-1*).

If the manufacturer is **not established in a Member State of the European Union**, approval can only be granted to his representative in France, duly accredited by the Minister responsible for transport (*Highway Code, art. R. 321-4*).

The manufacturer must meet the requirements of establishment (suitable premises), professional integrity (civil liability insurance for motor vehicles), financial standing (capital and reserves; guarantees from one or more financial organisations) and professional competence (skills, professional liability insurance for repairers). In particular, he must be able to provide the following guarantees :

[9] Hydrogen internal combustion engine vehicle

- guarantee the **preservation of the integrity of all the elements of the vehicle** which have been modified by means of an electrical modification device which he places on the market,
- assume **responsibility for any deterioration** of all the elements of the modified vehicle and of any part which may come into contact with or be damaged by all or part of the electrical modification device, and must demonstrate his ability to do so.

The “manufacturer” designs the system and process, obtains the approval for a prototype, and then produces the “kit” (components) and produce the specifications for the standard conversion process. The manufacturer then **approves and controls a series of accredited local “installers”** and provides the manufacturer guarantee. This framework is currently pilot tested by a dozen of companies, which are required to report annually to the government a the number of key metrics including customer satisfaction.

2.3.8 Conditions for the H2 retrofit company

The retrofit company is called an **‘Installer’** (installateur, *H2 retrofit decree 2020, art. 2, 7°*). This is the professional authorised by the manufacturer to install the conversion device in accordance with the manufacturer's instructions, and who **appears on the list of installers declared by this manufacturer** and whose APE code (main activity carried out) within the French activity nomenclature (NAF rev. 2) belongs to one of the following sections:

-section C-29: automotive industry;
-section C-30: manufacture of other transport equipment;
-section G-45: sale and repair of motor vehicles and motorcycles.

The installer must also meet the requirements of **establishment** (suitable premises), **professional integrity** (motor vehicle civil liability insurance), **financial capacity** (capital and reserves; guarantees provided by one or more financial organisations) and **professional capacity** (skills, garage professional civil liability).

He is responsible for verifying that the conditions for converting the vehicle are compatible with the safety requirements for the approval of the vehicle on which it is installed. In addition, he must ensure that the vehicle to be converted is in good mechanical condition.

At the end of the conversion, the installer must **provide the manufacturer with a conversion certificate**, the model of which can be found in Appendix II of the *H2 retrofit decree 2020*. On the basis of this conversion certificate, the manufacturer must issue and sign a **certificate of**

conformity, the model of which appears in Appendix III ter of the decree of 19 July 1954. This document must be sent to the holder of the registration certificate so that the registration certificate of the converted vehicle can be updated.

The retrofit company must provide the customer with a document setting out the **terms and conditions of his guarantee** and this information must be brought to the attention of the holders of the registration certificates of the converted vehicles (*Approval of motor vehicles decree 1954, art. 12 ter, §5*).

2.3.9 International or European technical requirements to be met for H2 conversion

In France, Annex III of the *H2 retrofit decree 2020* sets out the technical requirements to be met by vehicles converted from internal combustion to battery or fuel cell electric drive. This annex III refers to European and international regulations (UN/ECE):

- **Hydrogen system** : **EU 2019/2144** or **UN/ECE/R134**[10] completed by the elements of the **implementing regulation EU 2021/535 (**Annex XIV : Hydrogen system material compatibility and fuelling receptacle)[11]
- Electric powertrain : **UN/ECE/ R100.02**[12] (for categories M and N)
- Electromagnetic compatibility : **UN/ECE/R10.05**[13] : emission and reception of electromagnetic waves
- Power of electric drive trains (motor net power) : **UN/ECE/ R85**[14]

[10] Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety-related performance of hydrogen-fuelled vehicles (HFCV)
[11] Implementing Regulation (EU) 2021/535 laying down rules for the application of Regulation (EU) 2019/2144 of the European Parliament and of the Council in respect of the uniform procedures and technical specifications for the type-approval of vehicles, and of systems, components and separate technical units intended for such vehicles, with regard to their general construction and safety
[12] Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric powertrain
[13] Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility
[14] Uniform provisions concerning the approval of internal combustion engines or electric drive trains intended for the propulsion of motor vehicles of categories M and N with regard to the measurement of net power and the maximum 30 minutes power of electric drive trains

- Sound level & AVAS (*Acoustic Vehicle Alert System*): **EU 540/2014, UN/ECE/R51**[15] and **UN/ECE/R138**[16]
- Consumption : **EU 715/2007** & **2017/1151**
- Braking: **UN/ECE/R13**[17] if the vehicle is equipped with an electric regenerative braking system
- Masses and dimensions : categories M ☞ **EU 2019/2144**[18] completed by the elements of the **implementing regulation EU 2021/535**

Annex III of the *H2 retrofit decree 2020* refers (in general terms and without naming them) to European regulations or their equivalent in UN/ECE regulations for the following subjects:

- Behaviour of the driving mechanism (maximum effort). **UN/ECE Regulation R79 (Steering equipment)** is not mentioned in the *H2 retrofit decree 2020*, but the French Pilot (Normandy's retrofitted coach) referred to it (see below);
- Identification of controls;
- Defrosting/demisting;
- Heating systems;
- Speed limitation device. **UN/ECE Regulation R89** is not mentioned in the *H2 retrofit decree 2020*, but the French Pilot (Normandy's retrofitted coach) referred to it (see below);
- Flammability;
- Characteristics of buses;
- Frontal impact;
- Side impact;
- Lighting installation;

and any other regulatory act affected by the conversion.

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[15] Uniform provisions concerning the approval of motor vehicles having at least four wheels with regard to their sound emissions
[16] Uniform provisions concerning the approval of Quiet Road Transport Vehicles with regard to their reduced audibility (QRTV
[17] Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking
[18] Regulation (EU) No 1230/2012 implementing Regulation (EC) No 661/2009 of the European Parliament and of the Council with regard to type-approval requirements for masses and dimensions of motor vehicles and their trailers and Regulation (EC) No 79/2009 on the type-approval of hydrogen-powered motor vehicles were repealed as of 6 July 2022 by Regulation (EU) 2019/2144 on the requirements for the type-approval of motor vehicles and their trailers, supplemented by Commission Implementing Regulation (EU) 2021/535 laying down rules for the application of Regulation (EU) 2019/2144 as regards uniform procedures and technical specifications for the type-approval of vehicles, and of systems, components and separate technical units intended for such vehicles, as regards their general construction characteristics and safety (Annex XIV : Hydrogen system material compatibility and fuelling receptacle)

With regard to the French Pilot (Normandy's retrofitted coach), TRANSDEV provided us with a list of regulations that required testing once the equipment had been installed on the vehicle :

Code	Type
ECE R10	Electromagnetic compatibility
ECE R100	Electric power train
ECE R51	Noise emissions
ECE R138	Acoustic Vehicle Alert System = Minimum sound level for electric vehicles
ECE R13	Braking
ECE R79	Steering equipment
ECE R89	Speed limitation device
EC 79/2009	Type-approval of hydrogen-powered motor vehicles

Although this list mentions that EC 79/2009 (which was still applicable at the time of the vehicle conversion) must be complied with, EU 2019/2144 or UN/ECE Regulation No 134, supplemented by the elements of Implementing EU 2021/535, must now be complied with.

2.3.10 Additional national technical requirements for H2 conversion

The *H2 retrofit decree 2020* **supplements** international or European requirements with certain national requirements (Annex III) :

◆ Electric powertrain : The dimensions are such that the battery packs and bindings are designed to withstand an acceleration of:

- 2 g in the longitudinal direction,
- 1 g in the transverse direction,
- 1 g in the down-up direction,
- 2 g in the up-down direction,

without exceeding a minimum of (75% of the elastic limit or 50% of the tensile strength) (*H2 retrofit decree 2020*, Ann. III, 5) ;

◆ Protection against unauthorized use : The electrical converting device must be designed to resist or prevent unauthorised tampering (*H2 retrofit decree 2020*, Ann. III, 3.2) ;

◆ Requirements relating to modifications to vehicle dimensions (length, width, height, wheelbase, overhang, tracks, etc.), see below « *Possible changes to the dimensions of the vehicle »*;

◆ Requirements relating to the power of the electric drive train: it must be within the closed range :

- 40%-100% for vehicles in categories M1, M2, N1 and N2
- 60%-100% for M3 and N3 vehicles

of the maximum power of the endothermic engine (*H2 retrofit decree 2020*, Ann. III, 4.3) ;

◆ The vehicle must be in good mechanical condition (*H2 retrofit decree 2020*, Annex III, 8) ;

◆ The conversion device must be durable. This means that it must be designed, manufactured and intended for installation in such a way as to offer reasonable resistance to corrosion, oxidation, vibration, mechanical stress and other stresses to which it is exposed under normal conditions of use (*H2 retrofit decree 2020*, Annex III, 7);

◆ Location and Identification of Hand Controls, Tell-tales and Indicators : The installation of the conversion device must not cause the on-board diagnosis (OBD) light, if any, of the converted vehicle to illuminate while the vehicle is in operation (*H2 retrofit decree 2020*, Ann. III, 3.1).

2.3.10.1 Possible changes to the dimensions of the vehicle

The dimensions of the basic vehicle (length, width, height, wheelbase, overhang, tracks, etc.) must not be altered by the conversion.

However, **certain modifications are possible** on vehicles in categories M1, M2, M3, N1, N2 and N3 *(H2 retrofit decree 2020, Ann. III, 4.4 modified by decree 12 Sept. 2023*) :

◆ an increase in height of no more than 80 cm in relation to the declared overall height of the original vehicle;
◆ a modification to the rear overhang within the limits specified by the manufacturer of the original vehicle (not applicable to M1 category vehicles).

2.3.10.2 Possible changes to the weight of the vehicle

The technically permissible **maximum mass** of the vehicle, the maximum laden mass of the permissible combination and the maximum permissible loads on each of the axles must not be altered by the conversion, unless explicit authorisation is given by the manufacturer of the original

vehicle. However, by way of **derogation**, the maximum permissible laden mass of the combination may be reduced or eliminated by conversion without the authorisation of the manufacturer of the base vehicle (*H2 retrofit decree 2020, Ann. III, 4.5 amended by decree 12 Sept. 2023*).

The unladen kerb weight of the vehicle after conversion may not exceed +/- 20% the unladen kerb weight of the vehicle to be converted (30% for vehicles in categories M3 and N3). For vehicles that have undergone several type-approvals, the unladen kerb weight of the last type-approval is taken as the reference (*H2 retrofit decree 2020, Ann. III, 4.6 modified by decree 12 Sept. 2023*).

The distribution of the unladen kerb weight between the axles (front / rear axle distribution) after conversion may not exceed the distribution between the axles of the base vehicle by +/- 10%, or by +/- 15% for N3 road tractors. For vehicles which have undergone more than one type-approval, the distribution between the axles of the last type-approval is taken as the reference (*H2 retrofit decree 2020, Ann. III, 4.7 modified by decree 12 Sept. 2023*).

2.3.11 Information for customers

The manufacturer must provide the installer (retrofit company), together with the electric conversion device and on a durable medium, with information on the **average GHG emissions avoided over 10 years of use** by converting the vehicle to electric power compared to continuing to use it with a combustion engine over the same period.

This amount of CO2 avoided over 10 years is indicated in Annex IV of the H2 2020 retrofit decree:

Vehicle type	Amount of CO2 avoided over 10 years
M1	-67%
N1	-60%
M2/M3	-87%
N2/N3	-87%

The manufacturer must also provide the following information to the installer's customers:

- instructions on the conditions and recommendations for use and maintenance of the converted vehicle,

- information on the manufacturer's warranty terms and conditions, in particular that any defects or malfunctions caused directly or indirectly by the conversion are not covered by the original vehicle manufacturer's commercial warranty in any way whatsoever (*H2 2020 retrofit decree, art. 7*).

2.3.12 H2 retrofit incentive policies in France

Public subsidies for hydrogen retrofitting of vehicles are tending to decrease. Nevertheless, public procurement rules are an interesting lever to help develop hydrogen retrofitting, particularly for coaches.

2.3.12.1 TIRUERT (Incentive Tax for the use of Renewable Energy in Transport)

TIRUERT replaced TIRIB (*Incentive Tax on the Incorporation of Biofuels*) in 2022. It is an incentive tax for the use of renewable energy in transport. It It is intended to meet the targets set by Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (RED 3). TIRUERT penalises **fuel suppliers** (taxpayers) if they do not incorporate enough renewable energy in the production of the fuels they sell.

Since 2023, renewable hydrogen and since 2024, low-carbon hydrogen, are taken into account when calculating the renewable incorporation rate. This refers to the quantities of energy contained in renewable or low-carbon hydrogen produced by electrolysis and supplied by the taxpayer for use in fuel cells in electric vehicle motors (*Customs Code, Art. 266 quindecies*). Renewable hydrogen also benefits from double counting (multiplication factor 2). This tax treatment has an impact on the price of hydrogen.

The TIRUERT will soon be reformed and replaced by a **new mechanism to encourage the reduction of carbon intensity in fuels** *(Incentives to Reduce the Carbon Intensity of Fuels - IRICC).* However, the French hydrogen sector (*France Hydrogène*) believes that this reform is not compatible with the objectives set by France in its revised National Hydrogen Strategy (April 2025) or with those set by RED 3.

2.3.12.2 Green extra depreciation Scheme (General Tax Code, art. 39 decies A - I bis)

The Green extra depreciation scheme (*dispositif du suramortissement vert*) encourages companies to invest by granting an exceptional deduction from taxable profits.

Since 2024, according to the General Tax Code (*art. 39 decies A - I bis*), companies subject to corporation tax or income tax under a real taxation regime may **deduct the cost, excluding financial costs, of converting** combustion engine vehicles to battery-powered electric vehicles or hydrogen fuel cell vehicles, when they are used for their business and recorded as fixed assets on their balance sheet.

The deduction applies to vehicles with a Gross Vehicle Weight Rating (GVWR) of 2.6 tonnes or more and whose conversion is undertaken **between 1 January 2024 and 31 December 2030**. It

applies to the company that has the conversion carried out or to the company that makes the first acquisition of a vehicle that has undergone such conversion with a view to its resale, where the contract for the acquisition of the vehicle is concluded between 1 January 2024 and 31 December 2030. This deduction may only be made once for the same vehicle.
The deduction rate is :

- 20% for vehicles with a maximum GVWR of 2.6 tonnes or more but less than 3.5 tonnes,
- 60% for vehicles with a maximum GVWR of 3.5 tonnes or more but less than 16 tonnes,
- and 40% for vehicles with a maximum GVWR of more than 16 tonnes.

This deduction applies:
- either to the conversion cost,
- or to the cost of purchasing a retrofitted vehicle,
- or to the cost of long-term rental of such retrofitted vehicles (finance lease, lease purchase or long-term rental).

2.3.12.3 Electric/H2 retrofit bonus

In 2020, a bonus (*prime rétrofit*) was introduced for the retrofitting of electric (electric motor or fuel cell) passenger cars, vans, two- or three-wheeled motor vehicles and quadricycles.
In 2022, this subsidy was extended to the retrofitting of M2 and M3 category vehicles (i.e. buses and coaches), as well as N2 and N3 category vehicles (commercial vehicles > 3.5t and >12t). The amount of the subsidy was set at 40% of the conversion cost, up to a maximum of €30,000 for vehicles in categories M2 or M3 and €50,000 for vehicles in categories N2 or N3 (Energy Code, Art. D. 251-8-2). However, this retrofit bonus was ultimately **abolished for M3 and N3 vehicles** at the beginning of 2023.
Currently, the electric retrofit bonus (electric or fuel cell propulsion) only applies to passenger cars (M1), vans and vehicles in category N2 (GVW less than or equal to 3.5t). The bonus (which is tending to decrease) for vans and N2 vehicles depends on the vehicle class within the meaning of Annex 1 to Regulation (EC) No 715/2007 :

- Class I: 40% of the purchase price up to a maximum of €4,000;
- Class II: 40% of the purchase price up to a maximum of €6,000;
- Class III: 40% of the purchase price up to a maximum of €8,000.

The retrofit subsidy also applies to two- and three-wheeled motor vehicles and quadricycles (€1,100).

2.3.12.4 Energy Saving Certificates Scheme (C2E)

The Energy Saving Certificates Scheme (*certificats d'économie d'énergie - C2E*) requires the energy suppliers to finance energy-saving measures such as vehicle retrofitting operations (passenger cars, vans, buses, coaches, heavy-duty vehicles).

However, this scheme provides subsidies **only for 100% electric retrofits (BEV)** and not for FCEV (fuel cell electric vehicle).

Example of C2E premium amount :

Exemple du montant de prime (ordre de grandeur)

TRA-EQ-129	ACHAT OU LOCATION D'UN VEHICULE LOURD ELECTRIQUE NEUF DE TRANSPORT DE MARCHANDISES OU ISSU D'UNE OPERATION DE RETROFIT ELECTRIQUE				
	Catégorie de véhicules	**Montant en KWh cumac par véhicules**	**Bonus**	**Montant en Kwh avec Bonus**	**Montant prime**
	Camion porteur > 3,5t et < 4,25t	222 300	4	889 200	4 446 €
	Camion porteur > 4,25t et < 7,5t	433 100	4	1 732 400	8 662 €
	Camion porteur > 7,5 et < 12t	671 500	3	2 014 500	10 073 €
	Camion porteur > 12t et < 19t	824 000	5	4 120 000	20 600 €
	Camion porteur > 19t et < 26t	1 015 700	5	5 078 500	25 393 €
	Camion porteur > 26t et Tracteur routier	1 918 500	4	7 674 000	38 370 €
	Rétrofit				
	Catégorie de véhicules				
	Camion porteur > 3,5t et < 4,25t	132 100	4	528 400	2 642 €
	Camion porteur > 4,25t et < 7,5t	257 300	4	1 029 200	5 146 €
	Camion porteur > 7,5 et < 12t	425 600	4	1 702 400	8 512 €
	Camion porteur > 12t et < 19t	522 200	4	2 088 800	10 444 €
	Camion porteur > 19t et < 26t	643 700	4	2 574 800	12 874 €
	Camion porteur > 26t et Tracteur routier	1 216 000	4	4 864 000	24 320 €

Purchase or lease of a new electric heavy goods vehicle or a vehicle converted to electric power.

Exemple du montant de prime (ordre de grandeur)

TRA-EQ-128	ACHAT OU LOCATION D'UN AUTOCAR OU D'AUTOBUS ELECTRIQUE NEUF OU REALISATION D'UNE OPERATION DE RETROFIT ELECTRIQUE				
	Capacité du véhicule	**Montant en KWh cumac par véhicules**	**Bonus**	**Montant en Kwh avec Bonus**	**Montant prime**
	Autocar issu d'une opération de rétrofit	1 049 900	4	4 199 600	20 998 €
	Autocar standard	1 602 800	4	6 411 200	32 056 €
	Autocar grande capacité	2 564 500	4	10 258 000	51 290 €
	Agglomération < ou égal 250 000 hab	1 538 500	4	6 154 000	30 770 €
	Autobus issu d'une opération de rétrofit	2 350 700	4	9 402 800	47 014 €
	Autobus standard	3 291 000	4	13 164 000	65 820 €
	Autobus grande capacité				
	Agglomération > 250 000 hab				
	Autobus issu d'une opération de rétrofit	769 200	4	3 076 800	15 384 €
	Autobus standard	1 175 300	4	4 701 200	23 506 €
	Autobus grande capacité	1 645 500	4	6 582 000	32 910 €

Standard : par défaut Catégorie
Grande capacité : Equipé d'un pantographe ou fonction de la batterie

Capacité de batterie pour un véhicule de 12 mètres	Capacité de batterie pour un véhicule de 18 mètres	Capacité de batterie pour un véhicule de 24 mètres
≥ 390 kWh	≥ 540 kWh	≥ 690 kWh

Purchase or hire of a new electric coach or bus, or conversion to electric power

2.3.12.5 Calls for projects

The call for projects '*Territorial Hydrogen Ecosystems'* launched in 2020 has enabled the financing of a number of investments in hydrogen mobility. In particular, **HYLIKO** has received public funding of €10.7 million (*France 2030 investment plan*) to finance its *Grand-ParHY* & *Grand-LHYon* hydrogen ecosystem projects. These projects involve the deployment over two years of **47 new or**

retrofitted hydrogen-powered heavy-duty vehicles and the creation of new hydrogen production and distribution infrastructure in the Paris and Lyon regions.
The latest call for projects (launched in April 2025 at the same time as the update of the *National Hydrogen Strategy*) does not provide for the financing of retrofitting operations but rather the acquisition of new hydrogen light commercial vehicles (N1 and M1 vehicles categories).

2.3.12.6 Local public aids

Some local authorities, such as regional councils, metropolitan authorities and municipalities, offer financial assistance for retrofitting vehicles to run on hydrogen. This assistance can be combined with national assistance, which is sometimes subject to a ceiling. However, the amount of assistance is modest and only applies to light commercial vehicles.

2.3.12.7 Public procurement

Pursuant to Directive 2009/33/EC '*on the promotion of clean road transport vehicles in support of low-emission mobility*', Member States are required to set minimum targets for the public procurement of vehicles. These are vehicles intended for use in **public services** (public passenger transport, waste collection, postal or parcel transport, etc.).

Contracting authorities[19] or entities must purchase a minimum percentage of 'clean vehicles' or ''zero-emission heavy duty vehicle' (using electricity or hydrogen in particular) when renewing their fleets through public procurement.

For France, the targets are as follows:

- **Trucks** (category N2 or N3 vehicles): 10% between 2 August 2021 and 31 December 2025, and 15% between 1 January 2026 and 31 December 2030,
- **Buses** (category M3 vehicles): 43% between 2 August 2021 and 31 December 2025, rising to 61% between 1 January 2026 and 31 December 2030.

Vehicles that meet the definition of 'clean vehicle'[20] or of 'zero-emission heavy-duty vehicle'[21] **as a result of retrofitting** may be counted as clean vehicles or zero-emission heavy-duty vehicles, respectively, for the purpose of compliance with the minimum procurement targets (*Dir. 2009/33/EC, art. 5.3*). Consequently, since 2021, contracting authorities or entities in France may

[19] State, regional or local authorities, bodies governed by public law or associations formed by one or more such authorities or one or more such bodies governed by public law.
[20] under point 4 of Article 4
[21] under point 5 of Article 4

fulfil these obligations by purchasing or leasing **retrofitted electric or hydrogen-powered vehicles :**

- **buses and coaches** (categories M2 and M3, *C. env., Arts. D. 224-15-5-1, para. 2 and D. 224-15-6, para. 2*),
- **Trucks** (categories N2 and N3, *C. env., Arts D. 224-15-9*).

In this context, UGAP (*Union of Public Purchasing Groups*), which is a central purchasing body for public purchasers, has been offering a retrofit service for converting combustion engine vehicles to electric or hydrogen powertrains in its catalogue since 2025.

This offer covers:

- The conversion of IVECO CROSSWAY coaches (Euro VI) to hydrogen with GCK Mobility;
- The conversion of IVECO CROSSWAY coaches (Euro VI) to electric with RETROFLEET;
- The conversion of RENAULT MASTER 3 phase 2 utility vehicles to electric with TOLV Systems.Cars, vans, two- or three-wheeled motor vehicles or quadricycles (C. env., Arts D. 224-15-12).

This regulatory change enables public sector organisations to fulfil their obligations to green their fleets by modifying their vehicles' engines. This is an interesting lever for the development and industrialisation of electric and hydrogen retrofitting.

2.4 GERMANY

2.4.1 H2 retrofit of duty vehicles in Germany

★ **CLEAN LOGISTIC** (a retrofitter of trucks) presented in 2022 a zero-emission truck with fuel cell technology[22]

- The H2-truck Fyuriant has one or more hydrogen storages with 40 kg and 350 bar
- Per storage one fuel cell is in operation
- Distance is 400 to 500 km
- Stationed in Hamburg
- Wants to retrofit 450 vehicles per year from 2024
- They see the biggest problem in the filling station infrastructure
- Bankruptcy in 2023[23]

★ **KEYOU AND BÜCKER + ESSING** want to retrofit trucks towards hydrogen combustion from 2029 on[24]

- Until 2028 they want to retrofit the first 1000 engines. The initial plan is to equip new vehicles (Daimler Actros) starting in 2026, followed by the conversion of used vehicles starting in 2029.
- Cooperation between KEYOU (hydrogen specialist) and BÜCKER + ESSING (a company specialized on retrofits)
- First 40-ton trucks shall be produced until 2026
  - Based on a Daimler-Actros
  - The volume of the storage should allow distances of up to 650 km
  - Official start for selling was end of November with a time restricted selling offer[25]
  - Hydrogen combustion engine

The H2 engine is based on a Daimler Actros with a 12.8-litre engine and will have an output of 346 kW.

[22] Wasserstoff: Mit Hochdruck zu emissionsfreien Nutzfahrzeugen
[23] Clean Logistics: Insolvenzverfahren eröffnet, Unternehmensteile verkauft
[24] Keyou und Bücker + Essing rüsten Lkw auf Wasserstoff um | amz.de
[25] Smart. Simple. Sustainable. | KEYOU H2 Mobility as a Service

★ **QUANTRON** offers retrofit services to convert diesel vehicles from 3.5 to 49 tons and medium to large buses[26]

o Bankruptcy in January 2025, but wants to continue according to press release from April 2025

2.4.2 National Authorities

The approval is given through a technical service : 15 technical services are permitted through the Federal Office for Motor Traffic for total vehicles[27].

2.4.3 Type-approval and Individual approval

Text : Straßenverkehrs-Zulassungs-Ordnung (StVZO)

o All parts and the system as a whole of the retrofit need to be approved before it can take part in the traffic

o It's an individual approval or, based on European Law, a type approval

o There is the possibility to get an approval for small series, which have a restriction in numbers, but some reduced requirements from different regulations[28].

2.4.4 Categories of vehicles eligible for H2 retrofit

The national regulations allow the retrofitting of **any vehicle**, when meeting the above-mentioned regulations and getting an approval from one of the permitted technical services.

2.4.5 International or European technical requirements to be met for H2 conversion

The general minimum standards are shown in the legal acts in the EU, the United Nations Economic Commission for Europe and national law like the German Straßenverkehrs-Zulassungs-Ordnung. For the storage system is the EC 79/2009 and / or the regulation no. 134 both on European level need to be met.
All the components need to be approved for the usage with hydrogen.

[26] https://www.enerdata.net/publications/executive-briefing/hydrogen-retrofitting-sustainable-transport.html
[27] verz_Gesfz_TD_ABD_dt_eng.xlsx
[28] Kraftfahrt-Bundesamt - Typgenehmigungserteilung

2.4.6 Additional national technical requirements for H2 conversion

The TÜV Association has published a technical information sheet[29] for the retrofit of conventional passenger cars and commercial vehicles to hydrogen (H2) propulsion.

- Includes requirements towards the impermeableness, the security for crashes and the environmental friendliness
- Sensor system to track leakages of the storage
- Individual examinations of the retrofitted vehicles[30]

2.4.7 Special features relating to the type-approval of a vehicle retrofitted in another State

If the vehicle is type approved in another European country, the vehicle is also approved in Germany[31].

2.4.8 H2 retrofit incentive policies in Germany

The German Federal Ministry for Digital and Transport had launched a funding program to support the retrofit for light and heavy commercial vehicles: "*Förderung von klimaschonenden Nutzfahrzeugen und dazugehöriger Tank- und Ladeinfrastruktur (06/2022)*"[32] according to the convention: „*Richtlinie über die Förderung von leichten und schweren Nutzfahrzeugen mit alternativen, klimaschonenden Antrieben und dazugehöriger Tank- und Ladeinfrastruktur für elektrisch betriebene Nutzfahrzeuge (reine Batterieelektrofahrzeuge, von außen aufladbare Hybridelektrofahrzeuge und Brennstoffzellenfahrzeuge) (Richtlinie KsNI)*" 2. August 2021

- Support for the activation of the market through the reduction of additional costs for investment in vehicles with alternative drive systems (battery electric, hydrogen fuel cell or hybrid overhead contact line). Eligible for funding was the purchase of retrofitted diesel vehicles of EU vehicle classes N2 and N3 to electric drive (battery or fuel cell).
- Vehicles need to be used for commercial purposes or to do public duties
- Support for refueling and loading infrastructure
- Support for feasability studies
- Support for the purchase of retrofitted diesel vehicles, if the retrofit itself was not funded
- Funding was 80 % of the additional costs

[29] Shop des TÜV Verband e.V.: Dokumente
[30] Neues Merkblatt für Umbau von Fahrzeugen auf Wasserstoff - TÜV-Verband
[31] Kraftfahrt-Bundesamt - Typgenehmigungserteilun
[32] Funding program to retrofit light and heavy commercial vehicles NOW

- There could be the commitment, that the recipients of the funding need to provide the data towards the accompanying research
- funding guidelines as described before
- 12 months for the purchase of vehicles and 24 months for refueling and loading infrastructure

Funding period is already over. No continuation of the KsNI funding program.

In July 2025, the German Federal Ministry of Transport (BMV) has published a new call for projects to support the transition of **buses** to alternative powertrains[33]. It aims to finance the acquisition of low-emission buses, including fuel cell models. Projects to **retrofit combustion engine vehicles** and investments in refuelling stations and maintenance facilities are also eligible.

[33] https://www.bmv.de/SharedDocs/DE/Pressemitteilungen/2025/034-schnieder-bus-foerderaufruf.html

2.5 NETHERLANDS

Summary:
The Netherlands differs from the other countries (Belgium, Denmark, France, Germany).
Unlike France and Belgium, the Netherlands does not have a specific law or decree dedicated to hydrogen retrofitting. Retrofitting is allowed under general vehicle modification laws (e.g., Regeling voertuigen), but not tailored to hydrogen.
The Netherlands allows both individual vehicle approval (IVA) and national type approval (NTA) for small series. However, prototype approval (as in France) is not clearly defined or commonly used.
The Netherlands permits modifications to vehicle dimensions and weight, provided they meet current technical standards. This is more flexible than Belgium, which restricts weight changes and axle load deviations to ±10%.
The SWIM subsidy (April–June 2025) supports hydrogen retrofitting, but it's short-term. Also requires collaboration between a transport company and a hydrogen refueling station operator.
Other countries (e.g., France) offer broader and longer-term incentives like tax depreciation, retrofit bonuses, and public procurement support.
The Netherlands lacks a structured national strategy or coalition for hydrogen retrofitting (unlike France's Coalition Rétrofit H2). Retrofitting is mostly driven by private initiatives and pilot projects.

2.5.1 H2 retrofit of duty vehicles in the Netherlands

Retrofitting duty vehicles in the Netherlands is not that popular (yet) because of the costly procedures. There are some companies that did that for individual vehicles as a pilot project, but those projects were funded by investors. Several companies are known to have carried out or been involved in this type of retrofit projects are: HyMove B.V., Green Planet, Holthausen Clean Technology.

✯ **Holthausen Clean Technology (Hoogezand)**: Specializes in converting diesel vehicles—such as garbage trucks, vans, and buses—into hydrogen-powered vehicles,

✯ **VDL Groep & Toyota Collaboration**: VDL Special Vehicles is partnering with Toyota to retrofit heavy-duty trucks with Toyota's hydrogen fuel cell technology,

✯ **NPS Driven (Eindhoven):** On Thursday 3 April 2025, NPS Driven unveiled its MH2X 250G hydrogen combustion engine. They use an existing six-cylinder diesel engine for this purpose. This engine has been converted in such a way that it can function on 100% green hydrogen. The prototype has been extensively tested by TNO and is now ready for use in the 250 kW H2 Power Generation.

2.5.2 National Authorities

The **RDW** (The Netherlands Vehicle Authority) or an authorized testing center tests the aspects affected by the modification against the requirements applicable at the time of the initial admission of your vehicle. This does not apply to a change to electric propulsion and installation of a gas system. In that case, the requirements applicable on the day of the modification inspection will be tested.

Some technical services and engineering firms are recognized by RDW to carry out part of the homologation or testing process. Final approval still requires validation or a certificate from RDW, even if external labs perform certain tests.

The RDW also draws attention to the fact that an applicant must demonstrate that the applicant's vehicle meets the specified requirements. They will be discussed in the further chapters of this report.

The company that is performing the hydrogen conversion must submit detailed technical documentation to the approval authority. Testing is performed by a Technical service. They make a test report and hand that out to the Approval authority, they are part of the approval application. Approval authorities rely on a combination of test lab reports, engineering documentation, component certifications, and regulatory standards to validate that a hydrogen vehicle conversion is safe, legal, and compliant.

2.5.3 National regulatory framework for the H2 retrofit of vehicles

In the Netherlands, unlike France or Belgium, there are no regulations specifically dedicated to H2 retrofitting of vehicles.
Retrofitting is permitted under national vehicle regulations. If you make modifications to a vehicle, the starting point of regulations lies in the legal basis of **Regeling voertuigen** **(Vehicle Regulations Law)** that is valid from 26-02-2025 to present. This describes the changes for which a vehicle must be reassessed and the requirements that apply.

2.5.4 Conversion device covered by national H2 retrofit regulations

Fuel cell, hydrogen internal combustion engine (ICE), Dual-Fuel (H_2 + Diesel) hybrid conversions and adding a hydrogen fuel cell to a battery-electric vehicle to extend range are permitted in the Netherlands.

Fuel cell systems must be certified, hydrogen storage tanks and valves must comply with regulatory acts.

2.5.5 Type of approval permitted by national regulations (type-approval and/or individual approval)

There are 2 types of approval : Individual Vehicle Approval (IVA) and National Type Approval (NTA) for small series of converted vehicles. To get individual approval the vehicle must comply with Hydrogen system safety, **EML-testen** (Emission, Environment, Noise), including pressure systems, emergency safety, ventilation.

RDW will require:

- **Noise test** (usually under UNECE R51 or R138 for electric)
- **EMC (Electromagnetic compatibility) compliance** (interference from electronics)
- Environmental safety (no fuel leaks, protection from external impact)

2.5.6 Categories of vehicles eligible for H2 retrofit

Vehicle tipe	Vehicle category	Description	Examples
Passenger car	M1	Motor vehicle on 4 or more wheels, designed and constructed for the transportation of persons, with up to 9 seats including driver's seat	Car, minivan, camper
Bus	M2 or M3	Motor vehicle on 4 or more wheels, designed and constructed for the transportation of persons, with more than 9 seats including driver's seat	Touringcar (coach), trolleybus
Light commercial vehicle (lighter than 3500 kg, F.1 on the registration certificate)	N1	Motor vehicle on 4 or more wheels, designed and built for the transportation of goods	Van
Heavy commercial vehicle (heavier than 3500 kg, F.1 on the registration certificate)	N2 or N3	Motor vehicle on 4 or more wheels, designed and built for the transportation of goods	Truck
Light trailer (including maximum load lighter than 3500 kg)	O1 or O2	Vehicle intended to be coupled to a motor vehicle	Box truck, caravan
Heavy trailer (heavier than 3500 kg)	O3 or O4	Vehicle intended to be coupled to a motor vehicle	Low-loader (semi-trailer)

Source: https://www.rdw.nl/particulier/paginas/voertuigcategorieen

Special vehicles like waste collection trucks, tow trucks, and emergency vehicles can be retrofitted to hydrogen in the Netherlands

2.5.7 Conditions for the manufacturer of the H2 kit

Manufacturer must provide a technical construction file, before approval, the system must undergo prototype testing. Comply with safety standards, provide documentation.

2.5.8 Conditions for the H2 retrofit company

Qualified personnel that are experienced to work with hydrogen technologies, including hydrogen fuel cells and hydrogen combustion engines. It must be certified by RDW (The Netherlands Vehicle Authority).
The company must comply with hydrogen safety regulations, such as ISO 19885 (for hydrogen storage systems).
The retrofit company must create a detailed technical report outlining all the modifications made to the vehicle. This conversion plan (ombouwplan) must be submitted for RDW (The Netherlands Vehicle Authority) approval.
After the retrofit, the company must submit the retrofitted vehicle to the RDW for inspection and approval.
Summed up:

- Qualified personnel,
- Certified processes for retrofitting, including relevant ISO certifications,
- Compliance with hydrogen safety standards,
- Detailed documentation (technical reports, conversion plans, component certifications),
- Access to hydrogen fueling infrastructure and proper test facilities,
- Safety management and risk assessments in place, including emergency response protocols,
- Post-retrofit support and maintenance services for vehicles.

2.5.9 International or European technical requirements to be for H2 conversion

In the Netherlands, the legal basis lies in Vehicle regulation (*Regeling voertuigen*). Technical requirements are aligned with EU regulations and standards and they are enforced by the RDW (Vehicle authority):

- Global Technical Regulation No.13 (Hydrogen and fuel cell vehicles),
- Hydrogen system :

- UN/ECE R134[34] updated with the requirements coming from (EU) 2021/535 (*see below*),
- Regulation (EU) 2019/2144 supplemented by Commission Implementing Regulation (EU) 2021/535[35] (Annex XIV : *Hydrogen system material compatibility and fuelling receptacle*).

- The retrofit must comply with EU Regulation 2018/858
- Electrical safety : UN/ECE R 100
- Electromagnetic safety : UN/ECE R 10

For new manufacturers it is suggested to use the ISO 19887[36] for components being state of art. (active since November 2024). General test methods, such as leak test, hydrostatic strength and excess torque resistance, are described in the **ISO 19887**.

In this it is described that the components not listed shall comply with H2, the pressure and the temperature range for which it is designed.

In general the **Global Technical Regulation No.13** (Hydrogen and fuel cell vehicles) is the manual on how to build a H2 vehicle, what to do and what not to do.

2.5.10 Additional national technical requirements for H2 conversion

Vehicle Regulation (*Regeling voertuigen*) applies for national technical requirements. Vehicles must comply with this regulation whether hydrogen installation is **originally manufactured** or **converted afterward.**

[34] Regulation No 134 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety-related performance of hydrogen-fuelled vehicles (HFCV) [2019/795]
[35] Commission implementing regulation (EU) 2021/535 laying down rules for the application of Regulation (EU) 2019/2144 of the European Parliament and of the Council as regards uniform procedures and technical specifications for the type-approval of vehicles, and of systems, components and separate technical units intended for such vehicles, as regards their general construction characteristics and safety
[36] Gaseous Hydrogen - Fuel system components for hydrogen fuelled vehicles - Part 1: Land vehicles

2.5.11 Possible changes to the dimensions and weight of the vehicle

In Chapter 6 of the **Vehicle Regulation Law** (*Modification of vehicle type approval*), article 6.3 states that in the event of a change in the construction or layout of a vehicle as a result of which the following vehicle data change and **no longer correspond** to the vehicle registration after this change, the vehicle must comply with the requirements set out in Chapter 3 (*Further rules relating to the approvals referred to in Chapter III of the Road Traffic Act 1994*).
So if you retrofit a vehicle to use hydrogen, and this changes its fuel type or propulsion system, Chapter 3 standards must be met.
Modifications of the dimensions or weight of the vehicle are allowed but they are regulated.
In article 6.1 part 3 is stated that the RDW (The Netherlands Vehicle Authority) tests the aspects, which are affected by the change, against the requirements as they were at the time of the first admission of your vehicle.
Article 6.2, paragraph 2 is stated that when you convert a vehicle to electric propulsion or a gaseous fuel system (such as hydrogen), the RDW assesses the modifications on the basis of the current technical requirements in force at the time of the inspection, not on the basis of the requirements in force when the vehicle was originally licensed.

2.5.12 Special features relating to the type-approval of a vehicle retrofitted in another State

If the conversion is certified by an accredited body and It aligns with Dutch safety and environmental rules, mutual recognition is possible.

2.5.13 H2 retrofit incentive policies in Netherlands

Subsidy for hydrogen in mobility (SWIM) - helps you fund new or upgrades to existing hydrogen filling stations, hydrogen vehicles, or the conversion of vehicles to hydrogen (retrofitting). Startdate 1 april 2025 till 18 june 2025. Total budget € 40.000.000. Applications must come from a collaboration between a transport company and a hydrogen refueling station operator.

Application Process:

- **Find a partner** (e.g., hydrogen station operator)
- **Develop a business case** and technical plan for the retrofit

https://www.rvo.nl/subsidies-financiering/waterstof-mobiliteit :

- If you purchase one or more hydrogen vehicles or opt for retrofitting, 80% of your additional costs will be eligible for subsidy. The maximum is €5 million per application. For new vehicles, you will receive subsidy on the difference between purchasing a fossil vehicle and an H2 vehicle. And for retrofitting, you will receive subsidy for the conversion costs.

In retrofitting case basically you need a partner and written plan (documents):

Preparing your application

Before submitting an application, please ensure that the following points are in order:

About the consortium

- You have formed a consortium (collaboration) with at least one hydrogen filling station operator and at least one company active in transport or logistics.
- You have recorded the agreements in a cooperation agreement. This has been signed by all participants and contains at least:
  - the purpose of the collaboration
  - the duration of the collaboration
  - names and signatures of all partners
  - confirmation that the participants appoint and authorise a lead partner.
- The condition for the collaboration partners is that they are not in financial difficulties at the time of the subsidy application within the meaning of Article 2, paragraph 18 of the AGVV. We also explain this article in the document Declaration of no enterprise in difficulties . Please send the completed declaration for all participants with the application form.

- **Apply via RVO (Netherlands Enterprise Agency)** during the application window

3 Analysis and recommendations

3.1 European and regulatory framework for H2 retrofit

There is no European regulatory framework specifically dedicated to hydrogen retrofitting of vehicles. Member States enforce compliance with the international (UN/ECE) and European type-approval of electric vehicles operating with an hydrogen system.

In particular :

- **Hydrogen system** : EU 2019/2144 or UN/ECE/R134 completed by the elements of the implementing Regulation EU 2021/535 (Annex XIV : *Hydrogen system materail compatibility and fuelling receptacle*)

Regulation (EC) No 79/2009[37] ***on type-approval of hydrogen-powered motor vehicles*** was the first European regulation that established requirements for the type-approval of motor vehicles with regard to hydrogen propulsion and for the type-approval of hydrogen components and hydrogen systems. This Regulation also established requirements for the installation of such components and systems. It was implemented by Regulation (EU) No 406/2010[38].

Regulation (EC) No 79/2009 was **repealed as of 6 July 2022 by Regulation (EU) 2019/2144**[39] . These regulations stipulate compliance with the requirements of **UN/ECE/134**[40] . However, UN/ECE/134 is not sufficiently comprehensive. In particular, it does not contain any requirements on **material compatibility and hydrogen embrittlement** for hydrogen systems and components for hydrogen-powered vehicles. Such requirements are necessary to ensure a high level of safety as regards material selection in hydrogen systems. Specific provisions for **liquefied hydrogen**

[37] Regulation (EC) No 79/2009 of the European Parliament and of the Council of 14 January 2009 on type-approval of hydrogen-powered motor vehicles
[38] Commission Regulation (EU) No 406/2010 of 26 April 2010 implementing Regulation (EC) No 79/2009 of the European Parliament and of the Council on type-approval of hydrogen-powered motor vehicles
[39] Regulation (EU) 2019/2144 of the European Parliament and of the Council of 27 November 2019 on type-approval requirements for motor vehicles and their trailers, and systems, components and separate technical units intended for such vehicles, as regards their general safety and the protection of vehicle occupants and vulnerable road users
[40] Regulation No 134 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety-related performance of hydrogen-fuelled vehicles (HFCV)

storage systems as well as geometries of the fuelling receptacles are also not yet included in UN/ECE/134.

Consequently, Regulation (EU) 2021/535[41] supplements UN/ECE/134 in these respects and must therefore also be complied with (*Annex XIV: Hydrogen system material compatibility and fuelling receptacle*). This is why Regulation (EU) 2021/535 contains technical specifications for the storage of liquefied hydrogen (see Annex XIV, sections B, C and D) and not for the storage of compressed hydrogen, which is already covered by **UN/ECE/R134**.

- **Electric powertrain** : UN/ECE/ R100
- **Power of electric drive trains** : UN/ECE/ R85
- **Sound level & AVAS** (Acoustic Vehicle Alert System): EU 540/2014 and UN/ECE/R138
- Consumption : EU 715/2007 & 2017/1151
- **Braking**: UN/ECE/R13 if the vehicle is equipped with an electric regenerative braking system
- **Electromagnetic compatibility** : UN/ECE/R10 : emission and reception of electromagnetic waves
- **Masses and dimensions**: categories M ☞ EU 2019/2144 completed by the elements of the implementing regulation EU 2021/535

However, these international and European regulations are **designed specifically for the approval of new hydrogen-powered vehicles**, not for existing ones that have been converted to run on hydrogen. This creates a regulatory grey area for Member States, leading them to interpret these regulations differently when approving hydrogen-retrofitted vehicles.

A few countries (notably Belgium and France) have adopted a regulatory framework specifically dedicated to electric or hydrogen retrofitting of vehicles. France has even introduced the world-first regulation for series electric and hydrogen retrofit in 2020 (approval of a “hydrogen kit” that can be installed on the same family of vehicles).

But these countries have drawn up specific national technical requirements that are not provided for in the legislation of other Member States.

[41] Commission Implementing Regulation (EU) 2021/535 of 31 March 2021 laying down rules for the application of Regulation (EU) 2019/2144 of the European Parliament and of the Council as regards uniform procedures and technical specifications for the type-approval of vehicles, and of systems, components and separate technical units intended for such vehicles, as regards their general construction characteristics and safety

And some countries have simplified their approval processes (Netherlands, Germany, Danemark) only for individual conversions.

3.2 A need for harmonisation of technical specifications and type-approval rules

When we compare our respective regulatory framework for H2 retrofit, we find that, although the technical requirements are generally the same, they may vary slightly from country to country.

For example:

- There are differences between countries regarding the **different versions of UN/ECE Regulations** to be complied with. For example :
    - **Electric powertrain** : UNE/ECE R. 100[42] (Netherlands), R. 100.01 (Belgium) or R.100.02 (France)
    - **Electromagnetic compatibility** : UNE/CE R.10 [43] (Netherlands) or R.10.05 (Belgium, France)
    - With regard to **burning behaviour**, **general construction** and **lighting**, French *retrofit decree 2020* refers (in general terms and without naming them) to European regulations or their equivalent in UN/ECE regulations, whereas other countries such as Belgium specify them (UN/ECE R118, UN/ECE R107, UN/ECE R48).

- National regulations sometimes refer to **Regulation (EC) 79/2009** on the type-approval of hydrogen-powered motor vehicles which was repealed as of 6 July 2022 by **Regulation (EU) 2019/2144** on the requirements for the type-approval of motor vehicles and their trailers, supplemented by Commission Implementing Regulation (EU) 2021/535 ;

- There are differences between **additional national technical requirements** concerning in particular:

[42] Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric power train
[43] Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility

- The **date of registration of the vehicule** to be converted : in certain countries there may be restrictions with regards to the **vehicle registration date**, while in others there are none. For example, in France the vehicle must have been registered in a definitive series for at least 5 years from the date of conversion. This 5-year period may be waived in the event of technical approval from the vehicle type manufacturer (*H2 retrofit decree 2020, art. 2, 1°, c and art. 3, 1°*). Whereas in Belgium there is no restrictions with regards the vehicle registration date;

- The **power of the electric powertrain** (motor power during 30) of the retrofitted vehicule : Belgian regulations[44] stipulate that it must be within the **closed range of 65 to 100%** of the maximum net power of the original engine (except for engines ≤60kW : 65-120%). This rule applies applies to all vehicles in categories M and N. Whereas French regulations stipulate that it must be within the **closed range of 60 to 100%** for M3 and N3 vehicles (**40% to 100%** for vehicles in categories M1, M2, N1 and N2).
  Still on the subject of electric powertrains, French regulation (*H2 retrofit decree 2020, Ann. III*) stipulates that the dimensions are such that the battery packs and bindings are designed to **withstand certain acceleration** (ex : 2 g in the longitudinal direction, 1 g in the transverse direction) without exceeding a minimum of (75% of the elastic limit or 50% of the tensile strength) ;

- The **authorized modifications to the dimensions of the base vehicle**, that is length, width, height, wheelbase, overhang and track : most national regulations prohibit the modification of these parameters. Conversely, French regulation has allowed certain modifications since 2023. e.g. it allows an increase in height of 80 cm, which allows hydrogen cylinders to be placed on the roof,

- The authorized modification to the **mass of the base vehicle** : national regulations allow for different modifications:

  - **France** : the unladen weight of a heavy vehicle (M3 and N3 categories) in running order after conversion may differ of +/- 30% of the unladen weight in running order of the base vehicle,

[44] And Italian decree 2022

- **Belgium** : the distribution of the mass in running order between the axles after conversion must not exceed by more than 10% the distribution between the axles of the base vehicle. France : 10% as well, but +/- 15% for N3 road tractors,

- **Danemark** : modifications of the weight limits must not exceed original manufacturer weight restrictions without **additional approval**,

- **The Netherlands** permits modifications to vehicle dimensions and weight, provided they meet current technical standards.

These differences between national regulations (technical prescriptions, type-approval systems) may **hinder the development of a European retrofitting industry** :

• E.g. a hydrogen-retrofitted vehicle approved in one EU country may not automatically be accepted in another due to differing interpretations, administrative procedures, and technical testing requirements,

• E.g. a retrofitted vehicle in one country may undergo new type-approval tests or modifications in order to be driven in another country,

• E.g. each EU member state may impose additional technical requirements, such as limits on weight changes or structural modifications.

There is **a demand from the H2 retrofit industry for harmonisation** of the technical specifications and type-approval rules for these vehicles. This would enable European retrofitting companies to operate within a common regulatory framework and encourage the development of this sector.

The **approval of H2 retrofit kits** for converting commercial vehicles of the same family should be encouraged and facilitated in order to industrialise the process and reduce the cost of retrofitting.

3.3 A political will

Although it remains weak, there is a political will to harmonise technical specifications and type-approval rules. The 2024 Regulation on emission performance standards for heavy-duty vehicles[45] recognizes that the market uptake of heavy-duty vehicles which are retrofitted to become zero-emission "*is hampered by the lack of harmonised technical and administrative rules for their approval*" and that "*the Commission should therefore consider the need for possible initiatives to promote the development of such harmonised rules*". (*recital 39*).

This regulation stipulates that "*By 30 June 2025, the Commission must submit (…) a report which considers the need to facilitate the uptake on the Union market of* ***heavy-duty vehicles which are retrofitted*** *to become zero-emission heavy-duty vehicles, including by way of harmonised rules*" (*Reg. [EU] 2019/1242 amended, art. 3b*). This report hasn't been published yet.

UNECE World Forum for Harmonization of Vehicle Regulations (WP.29) has launched in March 2025 a new informal working group[46] to develop globally harmonized provisions for electric vehicle and hydrogen fuel cell retrofit systems. This informal working group has announced its intention to develop **a new UN Regulation** for electric vehicle retrofit systems and hydrogen fuel cell powertrains for light- and heavy-duty vehicles. Such harmonized regulatory framework would ensure minimum requirements for retrofit systems, provide robust performance requirements for converted vehicles and support the deployment of **retrofit systems that could be installed on many vehicles in the countries that adopt the developed requirements**.

This work is led by France and Spain, with support from Sweden, Germany, UK, Japan and the European Commission. The new UNECE informal working group is expected to deliver on harmonized requirements for targeted vehicle categories and powertrain types by **2027**.

[45] Regulation (EU) 2024/1610 amending Regulation (EU) 2019/1242 as regards strengthening the CO2 emission performance standards for new heavy-duty vehicles and integrating reporting obligations contains the following provisions

[46] Informal Working Group on Electric Vehicle (EV) / Hydrogen Fuel Cell Vehicles (HFCV) Retrofit Systems (IWG on EV/HFCV Retrofit Systems)

3.4 Other areas of improvement

3.4.1 Public procurement

Demand should be consolidated to reduce costs, in particular by **clearly integrating H2 retrofit option into public and private fleet greening policies**, as permitted by Directive 2009/33/EC on the promotion of clean road transport vehicles in support of low-emission mobility.

Pursuant to this directive, Member States are required to set minimum targets for the public procurement of vehicles. These are vehicles intended for use in **public services** (public passenger transport, waste collection, postal or parcel transport, etc.).

Contracting authorities[47] or entities must purchase a minimum percentage of 'clean vehicles' or **'zero-emission heavy duty vehicle'** (using electricity or hydrogen in particular) when renewing their fleets through public procurement.

Vehicles that meet the definition of 'clean vehicle'[48] or of 'zero-emission heavy-duty vehicle'[49] **as a result of retrofitting** may be counted as clean vehicles or zero-emission heavy-duty vehicles, respectively, for the purpose of compliance with the minimum procurement targets (*Dir. 2009/33/EC, art. 5.3*).

Consequently, national legislation should make use of this possibility provided for in the Directive 2009/33/EC.

3.4.2 Long-term rental schemes

Long-term rental schemes (moderate cost and provision of a replacement vehicle in the event of breakdown) should be encouraged, with the provision of a maintenance service and, where possible, refuelling. Shippers should be mobilised and encouraged to participate in trials.

3.4.3 Clean mobility subsidy schemes and green financing programs

Subsidies for retrofitting commercial vehicles with hydrogen (in the form of tax incentives, calls for projects and grants, for example) are **rarely long-term**, and are even declining in some countries.

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[47] State, regional or local authorities, bodies governed by public law or associations formed by one or more such authorities or one or more such bodies governed by public law.
[48] under point 4 of Article 4
[49] under point 5 of Article 4

Clean mobility subsidy schemes and green financing programs should **clearly identify hydrogen retrofit as an eligible mobility decarbonization pathway**.

3.4.4 H2 stations and maintenance technicians

Market uptake of hydrogen fuelled road transport vehicles needs vehicle availability but also **affordability of green hydrogen**. This is one of the conclusions of the Commission's report on the technological and market readiness of heavy-duty road transport vehicles (*COM [2025] 260, 27.5.2025*). A sufficiently dense network of H2 stations and maintenance technicians trained in this technology should be developed.

3.4.5 Working on the total cost of ownership

As Wopke Hoekstra[50] points out[51], it is important to improve the benefits associated with using a zero-emission truck vs a conventional truck over its lifetime. Today it's more expensive to buy an electric or hydrogen truck. But this can change if, afterwards, this purchase translates into lower road tolls, lower refuelling/recharging costs, cheaper maintenance and so on.

To conclude, we believe that collaboration is needed between technology suppliers, policymakers, and fleet operators to make progress on the issue of hydrogen retrofitting of commercial vehicles, as hydrogen propulsion is a medium-term solution for decarbonising road transport.

[50] European Commissioner for Climate, Net-Zero and Clean Growth
[51] https://www.linkedin.com/feed/update/urn:li:activity:7372280835372113920/

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