Hydrogen Blended Biofuel Trucks

When the energy transition meets the road
Project storytelling document

CONTENTS

1 The challenge of decarbonising heavy transport

The energy transition represents one of the deepest industrial transformations of our time. In recent years, public debate has focused mainly on electric mobility and on reducing emissions in urban transport and private mobility.

However, there is one sector where the challenge is far more complex: long-haul heavy transport.

Trucks and logistics fleets represent the circulatory system of the global economy. Every day they transport goods, connect industries, supply cities and ensure the continuity of production chains.

At the same time, road freight transport is one of the sectors most difficult to decarbonise.

To operate efficiently, a heavy-duty vehicle must guarantee:

- extensive operating range
- fast refuelling times
- high load capacity
- mechanical reliability
- economic sustainability

These characteristics make the sector one of the so-called “hard-to-abate sectors”, namely industrial sectors in which reducing emissions is particularly complex.

For this reason, the energy transition of heavy transport cannot rely on a single technology.

The sector is exploring several energy pathways:

- battery electric
- advanced biofuels
- e-fuels
- hydrogen

In this scenario, a crucial question emerges:

how can new energy solutions be introduced without compromising logistics operations?

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2 Why a new technological pathway is needed

The energy transition cannot be only an environmental objective. It must also be industrially sustainable.

Transport companies operate every day in a competitive context in which operational efficiency, reliability and service continuity are essential factors.

This means that new technologies must be able to integrate progressively into existing systems.

The challenge is not only to invent new engines or new fuels, but to build realistic transition pathways.

The H-DUAL project was born precisely from this awareness.

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3 The H-DUAL project

H-DUAL is an experimental project that explores the introduction of hydrogen into heavy transport through a pragmatic technological approach.

The project involves testing a road tractor powered by HVO (Hydrotreated Vegetable Oil), modified to also use hydrogen or a blend of hydrogen and biomethane, a solution known as HydroBioMethane.

The technological principle behind the testing is the dual-fuel system.

This architecture makes it possible to combine multiple energy sources within the same engine system, gradually introducing hydrogen into the combustion process.

The vehicle will be used in real operating conditions to collect data on:

- engine performance
- energy consumption
- emissions
- vehicle behaviour in real logistics operations

The aim is to turn technological experimentation into concrete operational knowledge.

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4 The meaning of the name H-DUAL

The project name summarises its fundamental principle.

The letter H refers to hydrogen, but also to the broader family of hydrogen-based fuels.

The word DUAL represents dual fuelling, namely the possibility of combining different energy sources within the same engine system.

The name therefore expresses the philosophy of the project:

integrating hydrogen into heavy transport through cooperation between different energy sources.
Not a sudden replacement, but a progressive evolution of the energy system.

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5 Hydrogen in the energy transition

In recent years, hydrogen has become one of the most widely discussed energy carriers in decarbonization strategies.

The European Union considers it one of the key tools for achieving climate neutrality targets in the most complex industrial sectors.

Heavy industry, maritime transport, aviation and heavy logistics are all areas in which hydrogen could play a fundamental role.

At the same time, it is necessary to maintain a realistic outlook.

Today, hydrogen presents several important challenges:

- production costs that are still high
- limited availability of green hydrogen
- distribution infrastructure still under development

For this reason, the spread of hydrogen will require time and testing.

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6 Energy blending: a pragmatic solution

At the heart of the H-DUAL project is the concept of energy blending.

Blending consists of progressively introducing new energy sources by combining them with fuels that are already available.

In the case of H-DUAL, hydrogen is integrated with fuels such as HVO or biomethane.

This approach offers several advantages:

- immediate reduction of emissions
- use of existing engines
- progressive introduction of hydrogen
- possibility of vehicle retrofit

Blending therefore represents a gradual form of energy transition, capable of supporting change without interrupting the operation of the logistics system.

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7 The project ecosystem

H-DUAL was created through collaboration between companies, research centres and logistics operators.

The project brings together different areas of expertise to build a concrete testing program.

The scientific pillar of the project is Politecnico di Milano, responsible for validating system performance and analysing emissions.

Technological development is led by Ecomotive Solutions, which designs and integrates the dual-fuel supply system.

SFBM contributes to the engineering integration, with expertise in system safety and reliability.

On the energy front, Greenture, a Snam Group company committed to developing infrastructure for sustainable mobility, is involved.

The operational laboratory of the project is LC3 Trasporti, which uses the experimental vehicle in its logistics activities.

The project also involves the manufacturer Ford Trucks, which represents the industrial dimension of the testing program.

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8 Research, industry and logistics

The strength of the H-DUAL project lies in the integration of different worlds.

Scientific research, technological development, energy infrastructure and operational logistics work together to build a real-world testing program.

This model reflects a growing awareness:

the energy transition is first and foremost a systemic challenge.

Only through collaboration between universities, industry and sector operators is it possible to develop solutions that are truly applicable.

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9 Road testing

The H-DUAL project is not limited to a technological demonstration.

The experimental vehicle will be used on the road to collect real operational data.

This phase will make it possible to analyze:

- dual-fuel system performance

- engine behaviour
- energy efficiency
- emissions
- economic impact within the operating cycle

The results of the testing program will help define new scenarios for the evolution of heavy-duty mobility.

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10 A first step towards the future

H-DUAL does not represent the definitive solution for decarbonizing heavy transport.

Rather, it is a concrete first step towards a more integrated energy system.

The project demonstrates that hydrogen can begin to enter heavy-duty mobility today, through flexible and progressively scalable technological solutions.

The energy transition will not happen through a single sudden revolution.

It will happen through many experiments, collaborations and gradual innovations.

H-DUAL represents one of them.

IN-DEPTH CONTENT

📦 BOX 1 - What is HVO

HVO (Hydrotreated Vegetable Oil) is an advanced biofuel produced through a hydrogenation process using vegetable oils and waste fats (such as used oils or animal residues).

Unlike traditional biodiesel, HVO:

- has a chemical composition very similar to fossil diesel
- is free from sulphur and aromatic compounds
- ensures cleaner combustion

Main advantages:

- Significant reduction in CO_2 emissions (up to 90% on a life-cycle basis)
- Compatibility with existing diesel engines (drop-in fuel)
- Better low-temperature performance than traditional biodiesel

👉 In summary: it is an immediate solution for decarbonizing without modifying the fleet.

📦 BOX 2 - What is IdroBioMetano

HydroBioMethane is a renewable fuel obtained by combining:

- **biomethane (produced from organic waste, agricultural residues or sludge)**
- **hydrogen (used to improve its energy and environmental performance)**

This integration makes it possible to:

- increase combustion efficiency
- further reduce emissions
- make the fuel more stable and higher-performing

Why it is interesting:

- it uses infrastructure that already exists (gas grid, distribution)
- it enhances the circular economy
- it represents a concrete bridge towards pure hydrogen

👉 It is a hybrid solution that combines sustainability and pragmatism.

📦 BOX 3 - How a dual-fuel engine works

A dual-fuel engine is designed to operate using two fuels at the same time, typically:

- diesel (or HVO) as the “pilot” fuel
- gas (methane, biomethane, hydrogen) as the main fuel

The principle is simple:

1. The gas is introduced into the combustion chamber
2. A small quantity of diesel/HVO is injected
3. The diesel triggers combustion of the gas

Result:

- lower emissions than pure diesel
- greater energy efficiency
- operational flexibility (the engine can also run on diesel only)

👉 It is a key technology for the transition, because it does not require an immediate revolution.

📦 BOX 4 - Why heavy transport is a “hard-to-abate” sector

Heavy transport (trucks, long-haul logistics, industrial vehicles) is considered “hard-to-abate” because it is difficult to decarbonize rapidly.

The main reasons:

- **High energy demand**
  Vehicles must travel long distances with heavy loads
- **Limits of electric technologies**
  Batteries are too large and heavy, with incompatible charging times
- **Insufficient infrastructure**
  Lack of widespread networks for charging or alternative refuelling
- **Operational constraints**
  Vehicle downtime has a direct economic cost

👉 This is why intermediate, scalable and immediately applicable solutions are needed.

📦 BOX 5 - The role of university research in the energy transition

The energy transition is not only an industrial challenge, but also a scientific and technological one.

Universities play a central role in several areas:

- development of new fuels and production processes
- optimisation of existing technologies
- independent analyses of environmental and economic impacts
- training the skills required by the sector

Collaboration between:
universities + companies + institutions
is what makes it possible to turn innovation into concrete solutions.

👉 Without applied research, the transition remains theory. With research, it becomes implementation.

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10 SENTENCES FOR SOCIAL MEDIA OR COMMUNICATION

1 The energy transition of heavy transport will not be the result of a single technology.

2 The future of sustainable mobility is born from the integration of different energy sources.

3 H-DUAL demonstrates that hydrogen can start travelling on our roads today.

4 True innovation is not only technological, but systemic.

5 The energy transition must be realistic as well as ambitious.

6 Energy blending makes it possible to introduce new solutions without stopping logistics.

7 Heavy transport is one of the most complex challenges in decarbonization.

8 Experimentation means turning technological hypotheses into real data.

9 Research, industry and logistics can work together to build the future of energy.

10 H-DUAL is a concrete experiment in the energy transition.

PROJECT TECHNICAL INFORMATION

Features (Technical Characteristics)

- Retrofit Technology: Conversion of existing diesel engines (road tractors and industrial vehicles in general) for operation in Dual-Fuel mode.
- Dual-Fuel Combustion: Hydrogen blending in the intake air flow, controlled cylinder by cylinder, with ignition through direct HVO injection, reduced in quantity to pilot injection.
- Flexible Blending: The system is designed to use hydrogen blended with low-emission fuels, specifically HVO + H_2 or HVO + HydroBioMethane (H_2 + BioCNG).
- Energy Substitution: Energy contribution of hydrogen in place of HVO, targeted at 30%.
- Dynamic Management: Ability of the system to support different operating modes and dynamic blending ratios between molecules (Hydrogen and Biomethane).
- High-Pressure Storage: use of dedicated hydrogen tanks at 350 bar.

PLUS (Advantages of the solution)

- Immediate reduction of emissions: Significant reduction of CO_2 and local pollutants (NOx, particulate matter) in heavy transport.
- Technological pragmatism: Use of existing engines and infrastructure, avoiding the immediate replacement of the entire fleet.
- Gradual transition: Progressive introduction of hydrogen into the energy system through blending.
- Operational sustainability: Maintaining long ranges and fast refuelling times, which are essential for long-haul logistics.