



Smart. Simple. Sustainable.
We decarbonize your fleet.

CLEAN ENGINES. REAL SUSTAINABILITY.

OUR OFFER MOBILITY WITHOUT CO₂

KEYOU is a successful clean mobility company based in Munich. With the help of our KEYOU-inside system, we convert existing diesel commercial vehicles into climate-neutral hydrogen vehicles. And thus enable our customers to be emission-free, efficient, and economical - without compromising on performance, capacity, or range. In addition to conversion and a climate-neutral "second life" for existing vehicles, we offer a "Hydrogen Mobility as a Service" approach giving customers a fully comprehensive hydrogen mobility solution - from vehicle conversion and provision of fuel to service and maintenance. "Zero Emission Mobility" thus becomes a reality with KEYOU.



Hydrogen - the fuel of the future



Conversion of engine and vehicle



H₂ Mobility as a Service

HUGE MARKET FOR EXISTING VEHICLES

Everyone talks about the future of mobility and new vehicles but what about existing vehicles? This is where we see the priority need: creating a green solution for existing trucks and buses.

AS ALWAYS. BUT GREEN.

The vehicle industry is challenged to develop technologies that can be easily and quickly integrated into existing engine platforms. Moreover, it should make existing diesel or gasoline engines clean and more efficient. KEYOU shows how a highly efficient hydrogen engine can be developed. With the help of lean combustion, intelligent operating strategy, and hydrogen-specific components, thus achieving the balancing act between economic efficiency, zero-emission, and maximum performance.

>99 %

of commercial vehicles driving on EU roads are Diesel-based.



MANUFACTURER INDEPENDENT

KEYOU-inside technology can be applied in all kinds of vehicles from all OEMs

ALL ENGINES SIZES & APPLICATIONS

No restrictions: all combustion engines can be converted to zero-emission H2 engines

LOW MODIFICATION EFFORT

Only minor changes to the base engine necessary

FAST INTEGRATION

Short time-to-market

KEYOU-inside Conversion Technology

- H2 Combustion Process
- Engine Operation Strategy
- H2 System (H2 HW / SW components)
- + Disruptive H2 Storage Technologies

LOW INTEGRATION COST

Low engine conversion cost

MARKET-READY

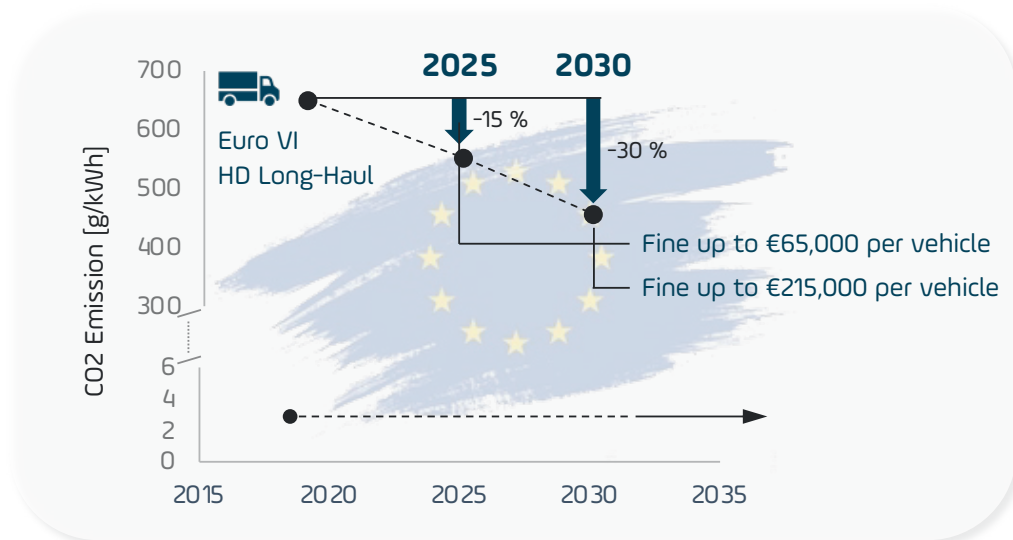
Validated technology and existing production infrastructure



STRICT CO2 REGULATIONS H2 MOBILITY WILL COME

CO2 limits – EU targets create facts

On the way to full decarbonization in 2050, the EU Commission has set regulatory CO2 emissions reduction targets of on-road commercial vehicles for 2025 and 2030.



Achievable with effective drivetrain technology

These targets can only be achieved with state-of-the-art technology, with alternative drive technologies that are sustainable and convince end consumers, fleet operators, and manufacturers alike. Moreover, ZERO EMISSION must not only be locally emission-free but also environmentally friendly during production and recyclable.

Advantage KEYOU-inside – meets ZERO EMISSION requirements 100 %

At approx. 0.1 g/kWh, hydrogen engines with KEYOU-inside are massively below the ZERO EMISSION limit defined by the EU. Your truck will, therefore, be able to operate under the „ZERO EMISSION“ label in the future.



“zero emission heavy-duty vehicle’ means a heavy-duty vehicle without an internal combustion engine, or with an **internal combustion engine that emits less than 1 g CO₂/kWh** as determined pursuant to Regulation (EC)

No 595/2009 and its implementing measures, or which emits less than 1 g CO₂/km as determined pursuant to Regulation (EC) No 715/2007 and its implementing measures.”

A better CO₂ footprint with KEYOU:

- Avoid cost of CO₂ certificates
- Reduces the CO₂ fleet balance
- Reduces your company's CO₂ footprint with KEYOU-inside



Hydrogen: hype or hope? In fact, hydrogen already plays a crucial role in the energy transition. Especially because green hydrogen imported into Europe will be cheaper than all types of domestically-produced hydrogen by the time imports to the continent begin in 2024.

HYDROGEN STRATEGY CLIMATE NEUTRAL EUROPE

The priority for the EU is to develop renewable hydrogen, produced using mainly wind and solar energy. Renewable hydrogen is the most compatible option with the EU's climate neutrality and zero pollution goal in the long term and the most coherent with an integrated energy system.

IMPLEMENTATION PHASES OF EU HYDROGEN STRATEGY

Kick-Start



Ramp-Up

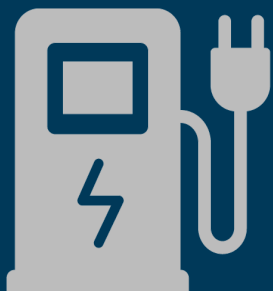


Market Growth



HYDROGEN WINS THE RACE AT THE PUMP

Domestic electricity generation based renewable energies



40-60 ct / kWh

Production & import of green hydrogen

1-3 ct / kWh Renewables MENA
4-8 ct / kWh MENA & Norway
Cross-border price



15-18 ct / kWh

Hydrogen up to 4x cheaper than electricity

In its transition to a fully clean and sustainable energy economy, Europe will need to import large quantities of renewable energies. Hydrogen, produced by renewable electrolysis in the most favorable regions close to Europe, can be distributed to European refueling stations at attractive prices.

SMART EVOLUTION INTO CLEAN MOBILITY

Everyone knows it, and everyone appreciates it: the reliable and powerful combustion engine. The downsides of mature diesel or gasoline engines are high emissions and damage to the environment. But there's a simple solution to solve this.

INNOVATIVE CONCEPT

We developed a proprietary low-temperature lean combustion concept that results in obtaining the highest performance with the lowest emissions.

HYDROGEN SYSTEM

The engine control system optimizes the management of the injection, air-charging, and ignition sub-systems, which have all been tailored for H₂ burn. Some key mechanical components were improved for high durability.

MAXIMUM PERFORMANCE

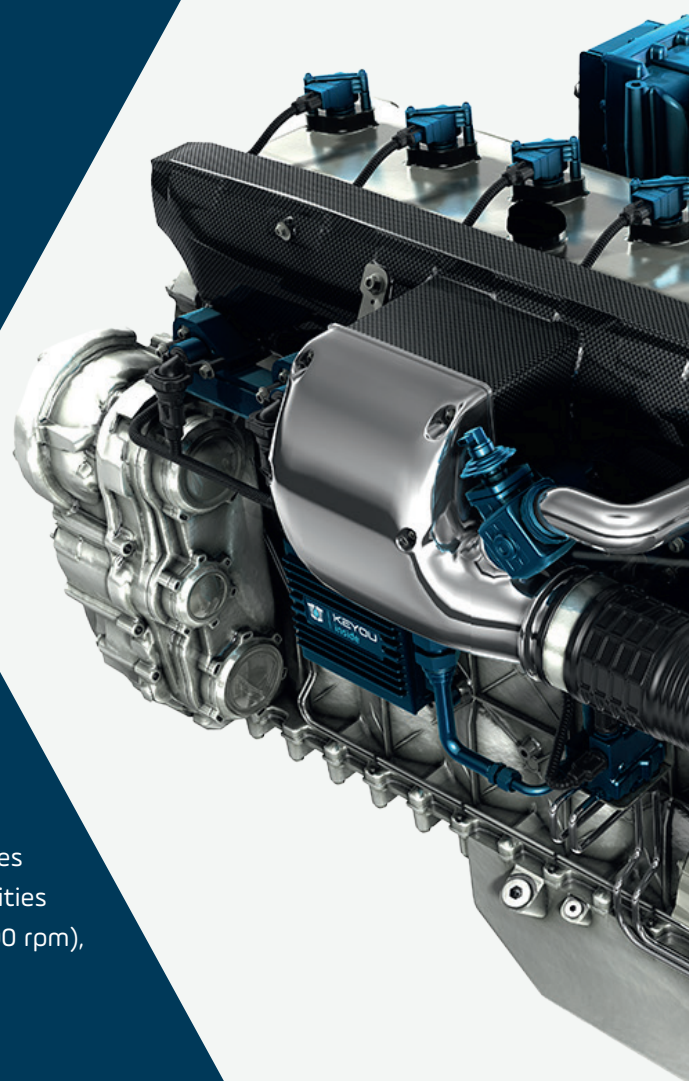
A smart engine operating strategy with the selected setup takes advantage of the H₂-fuel properties allowing: high power densities (27 kW/L), high low-end torque (90% of maximum torque at 900 rpm), and high brake efficiency (peak of 44.5%).

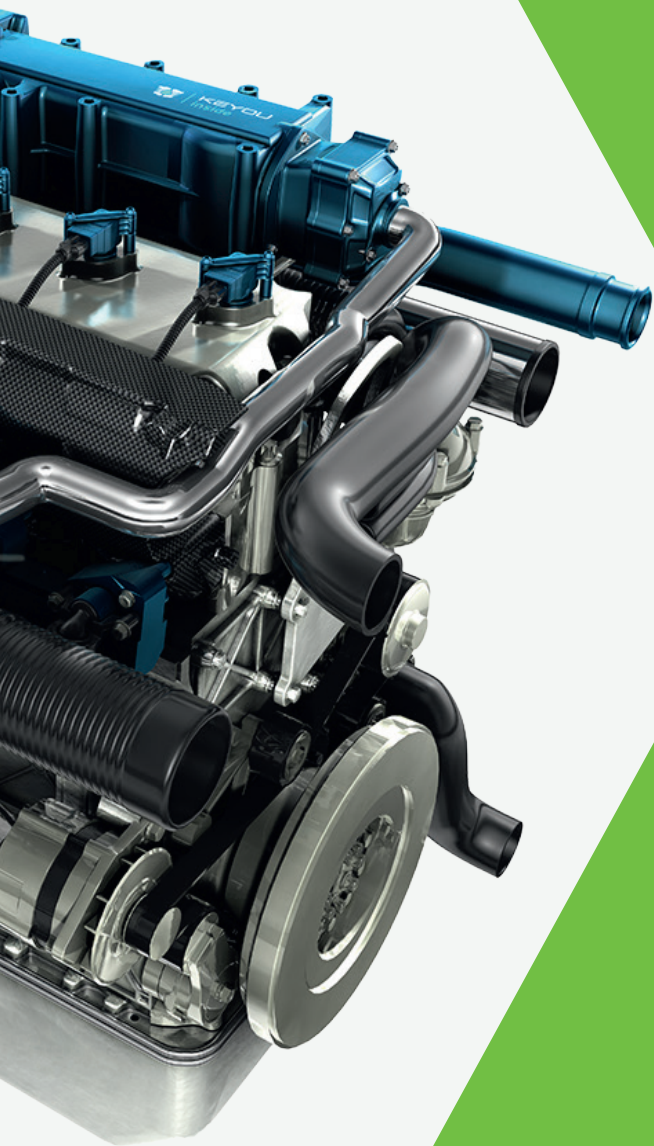
ZERO EMISSION

H₂ combustion emits water vapor. Traces of CO₂ originating from the lubricating oil are close to zero, as are NO_x emissions due to the low combustion temperature achieved.

ROBUST & COST-EFFECTIVE

Built on top of a mature diesel engine base platform, KEYOU's H₂-Engine offers the same high reliability and durability as Diesel engines. Due to the low modification effort and the fast integration of new components, the extra cost to pay is low.

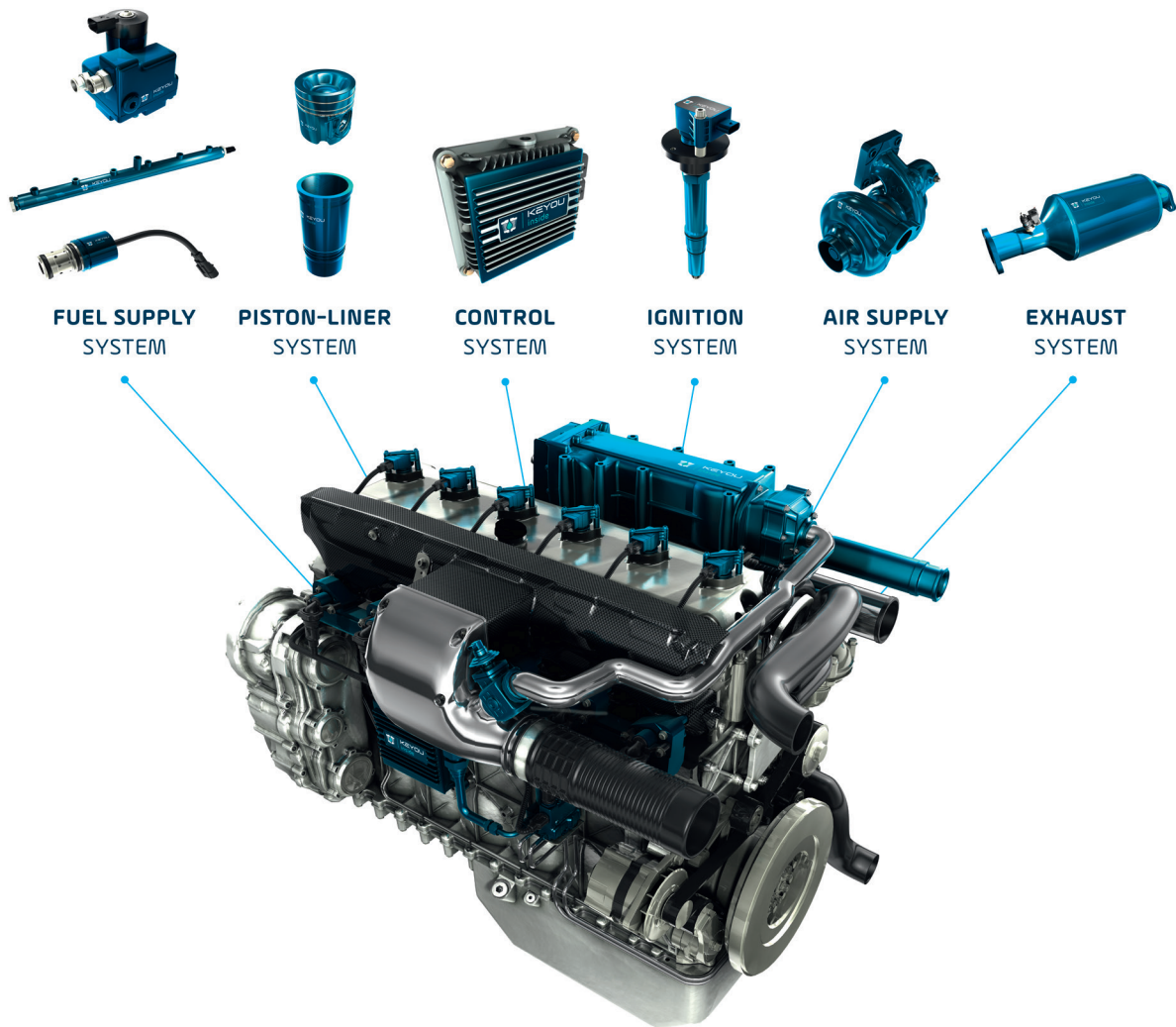




A NEW GENERATION OF HYDROGEN ENGINES

Past hydrogen engines have been clean but delivered low performance and involved complex adaptation work. KEYOU changes the paradigm by transforming existing diesel engines into hydrogen engines in the most effective way, by smartly utilizing the same base components and just upgrading the core sub-systems necessary for an optimal hydrogen combustion operation. The result is that hydrogen engines are now at the same level as diesel engines in terms of performance, robustness, and cost but without harmful emissions.

THE NEW HYDROGEN ENGINE FINE-TUNED SYSTEM



The transformation of a Diesel engine into a H₂ engine involves the integration of a new fuel supply, a properly matched air supply and the addition of an ignition sub-system. Moreover, some key mechanical components such as the piston-liner require a proper adaptation, and the exhaust is highly simplified. Finally, a dedicated electronic control unit with embedded operation software manages the whole system in the best possible way.

MAXIMUM PERFORMANCE ZERO EMISSION

From concept to reality.

Today the public demands clean cities and affordable public transport. With KEYOU-inside for hydrogen engines, emission-free commercial vehicles are within reach, becoming a reality on our streets. This emission-free technology combines all advantages of already existing drive systems.

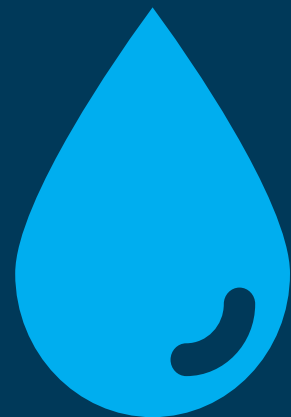
KEYOU-INSIDE CONVERSION TO H2 ENGINES

Sustainable. Clean. Uncompromising.

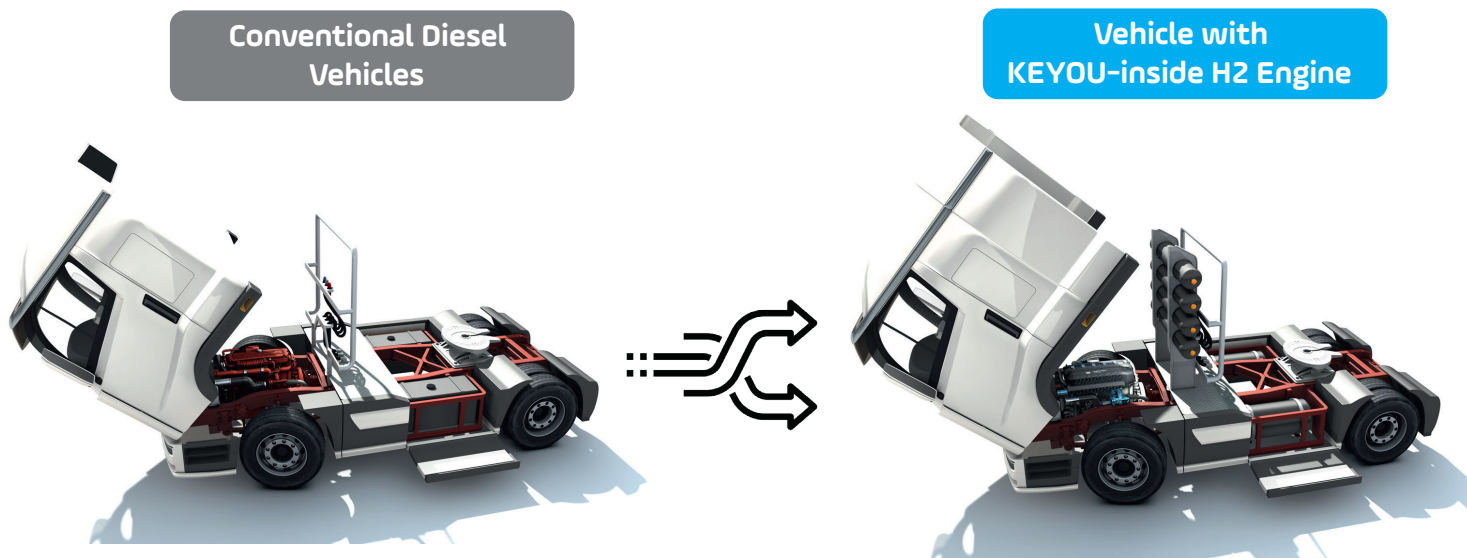
KEYOU-inside combines hydrogen as a sustainable fuel with the proven and economical combustion engine technology to create a quantum leap in drivetrain development. For the first time, there is an emission-free, cost-efficient, and powerful engine – a technology without compromises!

KEYOU-inside for your vehicle means:

- + Similar driving ranges
- + High performance
- + High availability
- + Fast refueling
- + Proven suitability for everyday use
- + Convincing cost efficiency
- + Long service life
- + Zero emissions



EXISTING VEHICLES BECOME GREEN



"SECOND LIFE" FOR EXISTING VEHICLES WITH KEYOU CONVERSION TECHNOLOGY

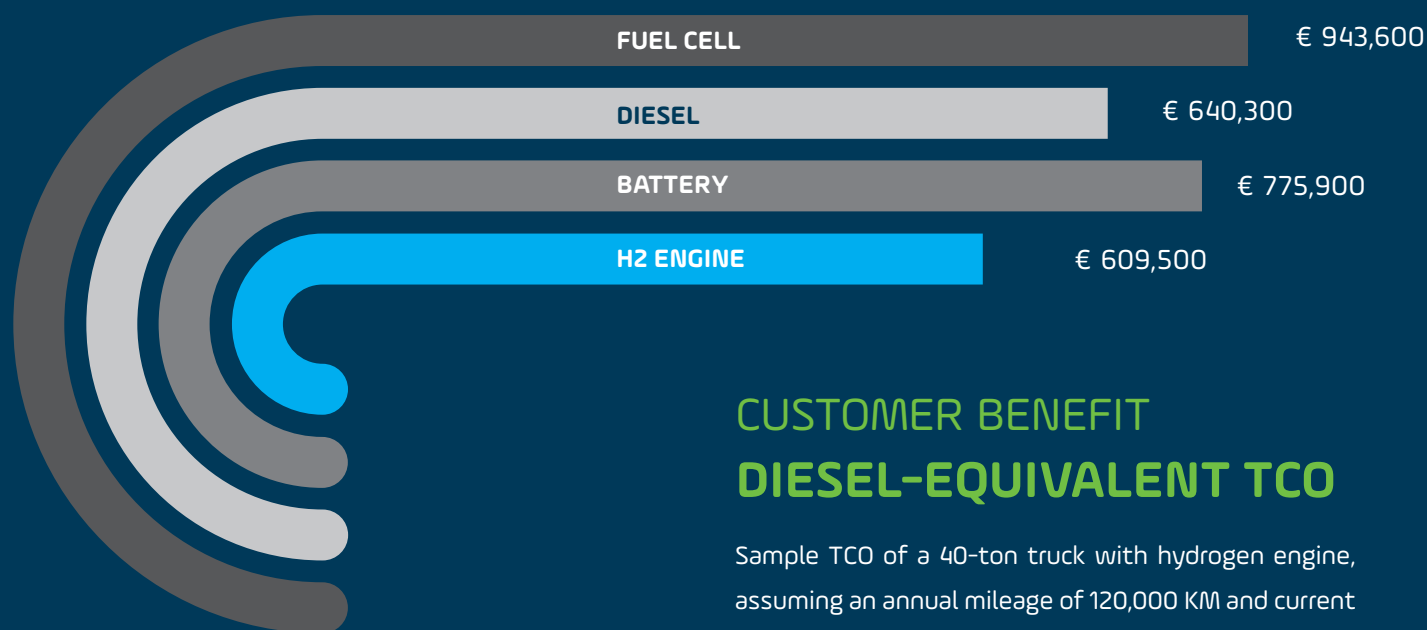
Most vehicles used by fleet operators, whether in logistics or urban transport, still consist of classic diesel trucks and buses. There is a great willingness to switch to CO₂-neutral drive technologies. However, companies still encounter obstacles on the way to decarbonizing their fleets. In many cases, the solutions currently on offer are not economically competitive and are only economically viable with the help of subsidies. New technologies are breaking old habits, causing additional high transformation and conversion costs in many places. In many cases, a solution for existing vehicles is missing. To achieve the climate protection goals in the commercial vehicle sector, we need a solution for existing vehicles. This is where KEYOU comes into play.

The innovative KEYOU-inside technology offers fleet operators the conversion of conventional diesel vehicles to CO₂-free hydrogen vehicles, which are considered zero-emission according to the EU standard ("Zero CO₂"). The advantage for the end customer: The complete retrofit solution, which includes an H₂ tank system and the conversion of the engine, offers a diesel-equivalent cost structure, billed in a "pay-per-use" model (€/km). The benchmark here is and remains the diesel. The advantages of the hydrogen engine and KEYOU's retrofit approach allow fleet operators to continue their proven business model while guaranteeing a "second life" for existing vehicles. Thus ensuring the continued use of an investment already made.



CLEAR ADVANTAGE FOR RETROFIT WITH KEYOU-INSIDE

With our H2 expertise, our technology, and conversion know-how we can best solve the big challenges of the commercial vehicle sector, offering a cost-efficient mobility solution without hazardous CO2 emissions.

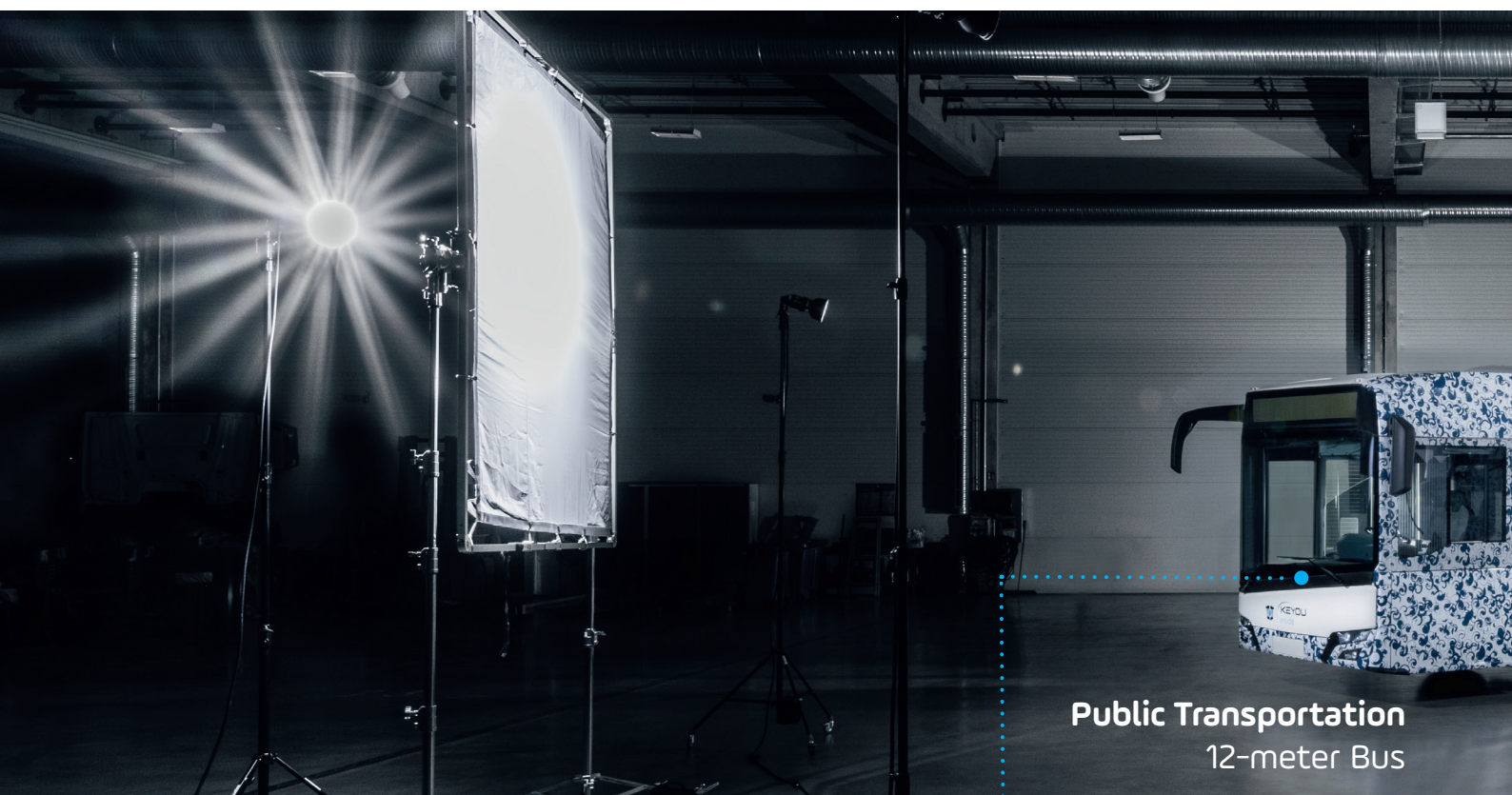


CUSTOMER BENEFIT DIESEL-EQUIVALENT TCO

Sample TCO of a 40-ton truck with hydrogen engine, assuming an annual mileage of 120,000 KM and current commercial energy prices.

STARTING POINT BUS & TRUCK

The 12m city bus and the 18t truck will be presented live to a broad audience for the first time in September 2022 at the IAA Transportation. "With our prototype vehicles, we are demonstrating that hydrogen engine technology also works in real life and is a cost-effective and robust alternative to battery electric or fuel cell vehicles," explains Thomas Korn, CEO, and co-founder of KEYOU GmbH. In the fourth quarter of 2023, we will start a pioneer program delivering the first H2 trucks to pre-selected customers.



Public Transportation
12-meter Bus

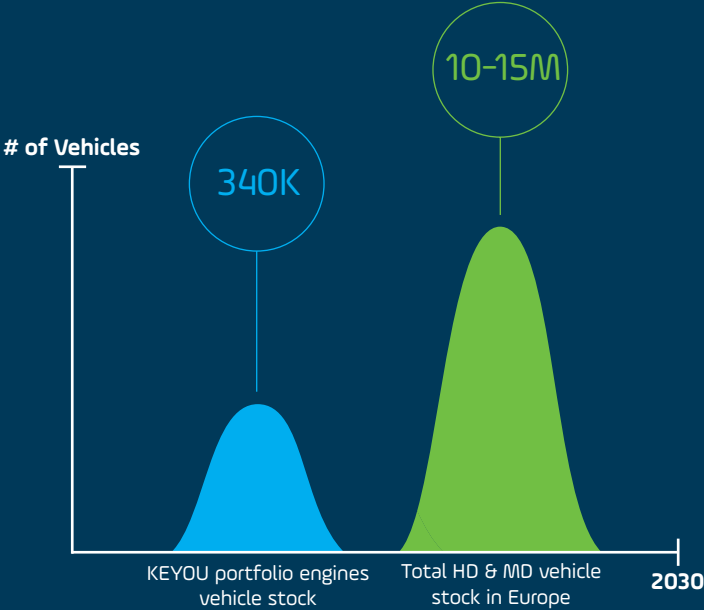
Both of our vehicles first enter into the market and are powered by the same 7.8L H2 engine. The power and torque delivered are in the same range of Diesel engines of this class. The 18-ton truck and 12-meter city bus will have different fuel consumptions and driving ranges. Individual tank system configurations allow us to adapt the driving ranges to specific customer needs.

| KEYOU H2-Technology (PFI) | |
|---------------------------|----------------------------------|
| Cylinders | 6 |
| Displacement | 7.8 liters |
| Air Supply | Turbo |
| Power | 210 kW |
| Maximum Torque | 1,000 Nm |
| Fuel Supply | Port Fuel Injection (PFI) |
| EATS | Not required (emissions < EU VI) |
| Consumption (H2 / 100 km) | Bus: ca. 10 kg / Truck: 7 kg |
| Range (tank 350 bar) | 350 km to 600 km* |

*with individual tank system configurations

TWO ENGINE PLATFORMS HUGE POTENTIAL

With only two engine platforms - 8l and 13l, KEYOU is looking at a retrofit market of approx. 340,000 vehicles in Europe alone. From 2025 onward, KEYOU plans to add one new engine platform per year.



Logistics & Transport
18-ton Truck

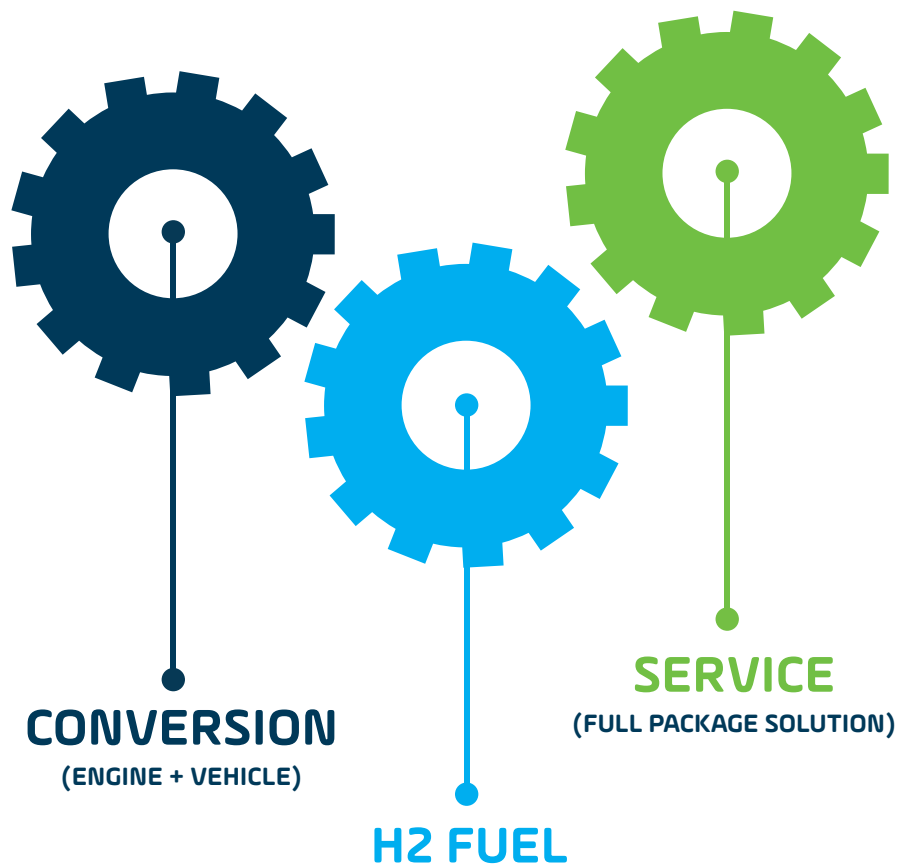
DRIVING RANGE TAILORED TO NEEDS

The hydrogen storage capacity installed in each vehicle is adaptable to what each specific operation requires. The two vehicles offer range potentials of up to 600 kilometers. With an output of 210 kW, not only is sufficient power provided but the bus and truck also remain below the zero-emission CO2 limit defined by the EU in the demanding WHTC reference cycles. Easily meeting the EURO 6 standard without expensive exhaust gas after-treatment.

WHAT WE OFFER

H2 MOBILITY AS A SERVICE

In addition to a holistic conversion and a climate-neutral "second life" for existing vehicles, the "Hydrogen Mobility as a Service" approach offers customers a fully comprehensive hydrogen mobility solution - from conversion and provision of fuel and infrastructure to insurance and service and maintenance. "Zero Emission Mobility" thus becomes a reality with KEYOU.



The KEYOU Hydrogen Mobility as a Service solution provides customers with a complete "pay-per-use" package (€/km) - without having to invest in purchasing vehicles nor in new infrastructure. The package includes cost-efficient conversion of the vehicles, fuel supply as well as service and maintenance. Guaranteeing not only customer satisfaction but also an easy entry into CO₂-free mobility. The total cost is competitive with Diesel vehicles operation from day 1.

FULLFILLING CUSTOMER NEEDS WITH THE RIGHT H2 SOLUTION

Transformation, mobility turnaround, CO2 directives - fleet operators face enormous challenges. It is not enough to do justice to customers and the climate; economic success must also continue to be ensured. The simpler a solution and the lower the conversion, the more willing an entrepreneur will be to decarbonize his fleet.

The right technology at the right time. With our intelligent KEYOU-inside technology, we focus on converting existing fleets by delivering vehicles and fuel to our customers. Through our partner network, we guarantee the usual standards for service and maintenance. By converting existing engines into powerful and highly efficient hydrogen engines, we not only offer an easy way to decarbonize our customers' fleets but also live up to our sustainability standards.

A simple "pay-per-use" rental model, on the one hand, eliminates complicated billing and high investments. While clear agreements on fuel supply ensure a high level of planning security for the end customer. "H2 Mobility as a Service" with KEYOU means a full package solution for the fleet operator - at a diesel-equivalent cost structure!

A PERFECT FIT FOR ALL KINDS OF APPLICATIONS

Engine Know-how. Conversion Technology. Hydrogen Expertise.

KEYOU offers holistic conversion technology for all kinds of applications. Ultimately, every machine that has a combustion engine today is eligible to be adapted to H₂ combustion to become clean. For the market entry, the company focuses on the medium and heavy-duty segment, which is, to date, one of the biggest polluters in the EU. By 2025, KEYOU will add one engine platform to its portfolio each year. By doing so, the Munich-based hydrogen expert opens up to a wide variety of customers from different industries.



KEYOU
inside



INNOVATIVE STRENGTH FOR SUSTAINABLE MOBILITY

Vision

Hydrogen produced from renewable energies is essential for the transition to a new, more sustainable energy paradigm and greener future. KEYOU's vision is to enable a sustainable and competitive mobility solution by converting existing commercial vehicles to hydrogen.

Company

KEYOU is YOUR KEY to innovative sustainable energy and clean mobility solutions. Founded in 2015 with the H2 engine at its very core, KEYOU has actively contributed to the reawakening of the automotive industry to this technology.

Founders

They have known each other for a long time and share a common vision: Thomas Korn, Markus Schneider, and Alvaro Sousa are three engineers, each of them with over 20 years of experience in research and development of alternative drives. With KEYOU, the three founders are pursuing a common goal: affordable and clean mobility based on the sustainable and energy-rich fuel of the future – hydrogen.



Thomas Korn



Markus Schneider



Alvaro Sousa



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