New strategies
of **the energy transition.**

BEST MIX

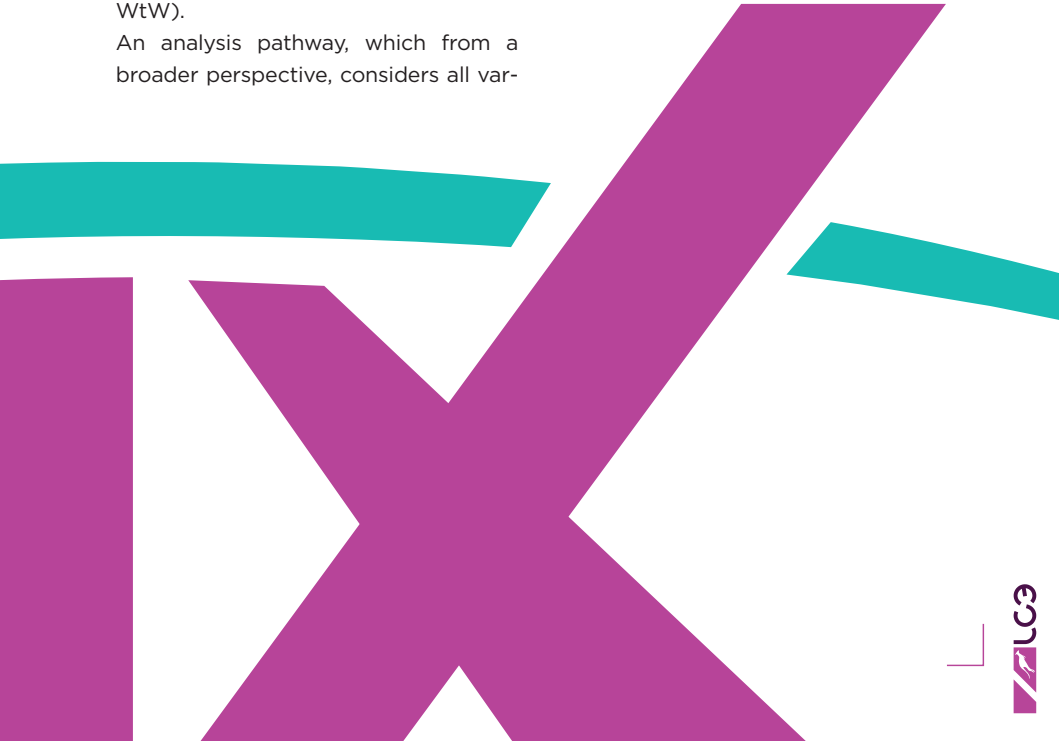
B.E.S.T. 2030: towards the decarbonisation of heavy transport.

The transition for the decarbonisation of heavy commercial transport will not come in the form of a single, distinct solution, rather it will consist of a mix of applications that will enable the implementation of the best choice based on service characteristics, completed by the selection of a combination of fuels and technologies.

Both are rapidly evolving, with the aim of cutting emissions as much as possible along the entire cycle (highlight WtW).

An analysis pathway, which from a broader perspective, considers all variables that influence the life cycle of a vehicle or fuel, and their environmental impact (LCA).

Assessing and understanding the advantages and disadvantages of each technology and fuel under each aspect places us in a position of neutrality, from which we consider not just the effectiveness of the deployed technology, but also the connection and correlation with fuel and other variables at play.

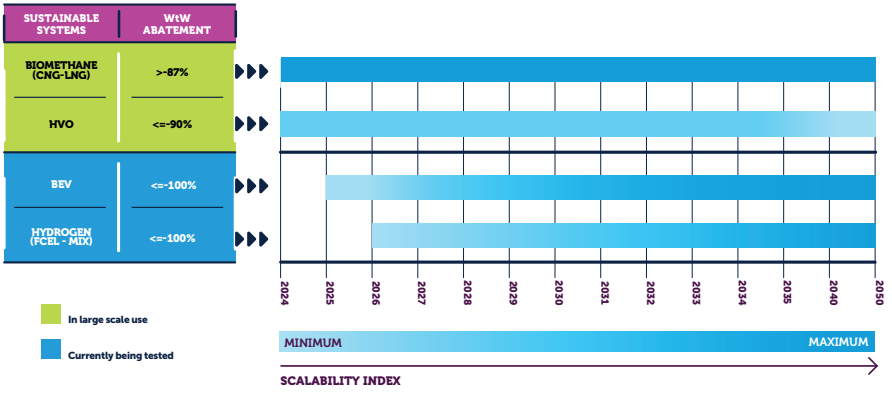


A sustainable, possible and measurable transition.

Comparing different propulsion technologies. (Well to wheel - WtW Analysis)

Well-to-Wheel is the first step to comparing the efficiency of different solutions to greenhouse gas (GHG) emissions, which cause drastic climate changes (climate-altering emissions), along with CO2.

Well–to–Wheel, WtW analysis enables the comparison of energy vectors and energy, right from generation/ extraction, as well as their use as HGV fuel, in an energy analysis that quantifies environmental impact within the entire cycle. The primary aim of this analysis is to compare different propulsion technologies and relative fuels required. This comparison is made by measuring the efficiency of the means of transport according to the performance of the technology, fuel or energy vector used, starting from fuel supply chain emissions, right up to direct emissions from its use.



The WELL-TO-WHEEL system, consists of two systems:

1

WELL–TO–TANK

WtT, from well to tank
DEFERRED EMISSIONS.

2

TANK–TO–WHEEL

TtW, from tank to wheel
DIRECT VEHICLE EMISSIONS.

Data updated January 2023

EUROPEAN LEGISLATION EMISSIONS LIMITS (TRUCKS) EU REGULATION 2019/631

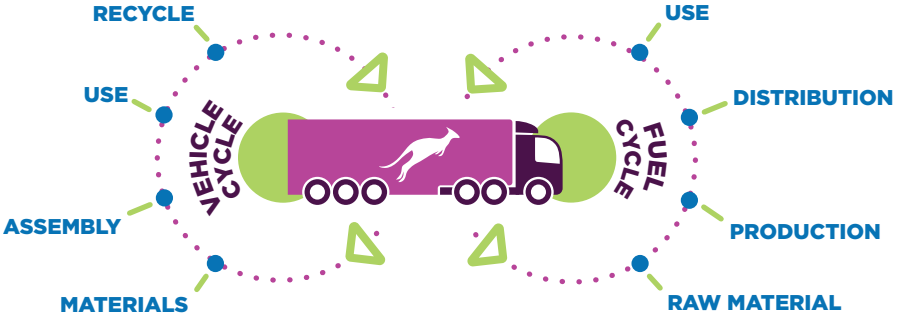
YEARS	2030	2035	2040	2050
EMISSIONS REDUCTION	-40%	-65%	-90%	-100%

LCA. The carbon footprint throughout a product's life, for the life of the environment.

LCA objectively quantifies energy and environmental loads and therefore the carbon footprint associated with a product/ process/ activity during its entire life cycle, from the purchase of raw materials to end-of-life.

In the case of heavy transport, the life cycle is considered from the extraction and/or processing of fuel or steel required to make a vehicle, right up to the actual level of transport emissions (WtW analysis) and the disposal of parts. This assessment is called LIFE CYCLE ASSESSMENT (LCA).

LIFE CYCLE ASSESSMENT



LC3 contributes towards the study of this topic with data collected to date in around 100 million of km travelled with alternative fuels, and over 100,000 km travelled with BEV HGVs. An experience shared with our stakeholders, enabling us to define our ideal strategic asset in this historic moment.

SUSTAINABLE SYSTEMS	APPLICATION	LCA	REFUELLING TIMES	AUTONOMY	AVAILABLE INFRASTRUCTURE	WtW ABATEMENT	TwT ON SITE EMISSIONS
BIOMETHANE (CNG-LNG)	MEDIUM/ LONG RANGE	GOOD	SHORT	HIGH	SUFFICIENT	>-87%	-22%
HVO	MEDIUM/ LONG RANGE	GOOD	SHORT	HIGH	EXCELLENT	<-90%	-0%
BEV	SHORT RANGE	NO GOOD	LONG	LOW	INSUFFICIENT	<=-100	-100%
HYDROGEN (FCEL + MIX)	SHORT/ MEDIUM LONG SERVICES	GOOD	SHORT	HIGH	TO BE DEVELOPED	<=-100	-100%

In large scale use

Currently being tested

For SUSTAINABLE transport, with less CO2, there is more than just one solution:

There are 4.

Choosing a **clean energy base** can go a long way, when certified with Well-to-Wheel (WtW). However the combined use of 4 solutions can take you even further.

The 4 pillars of BEST mix.

HVO.
THE SIMPLEST TECHNOLOGY, THE MOST SUSTAINABLE DIESEL.

BIO METHANE
(BIO-LNG AND BIO-CNG).
THE IMMEDIATE, EFFICIENT, FOSSIL FREE SOLUTION.

FULL ELECTRIC.
ZERO EMISSIONS.
ZERO NOISE.

HYDROGEN.
THE END OF THE FOSSIL AGE.

The combined use of all 4 solutions can do so much more than opting for a single one, since each has its peculiarities and fields of application.

HVO.

The simplest technology, the most sustainable diesel.

HVO is a premium diesel product made entirely from renewable raw materials. It is the most sustainable fuel for diesel vehicles on the market, with up to 30% less fine particle emissions, 9% less nitrogen oxide (NOX) and **up to 90% less CO2 compared to diesel values reported in RED II.**

It is the simplest applicable technology, as it does not require any technological updating of vehicles and simply involves the use of an intrinsically sustainable bi-ofuel.
The abatement of emissions calculated in the Well-to-Wheel cycle is important. However, the emissions abatement rate varies according to the HVO matrix of provenance.

↑ ADVANTAGES

- **No technological fleet updating required**
- **Autonomies comparable to current levels**
- **Easy refuelling.**

↓ DISADVANTAGES

- **No benefit from the reduction of on site emissions**
- **Endothermic combustion like current Diesel**
- **Limited quantities on the market.**

Bio Methane.

(BIO-LNG and BIO-CNG)

The immediate, efficient and fossil-free solution.

Bio Methane is the ready and immediately usable solution for fossil free transport. A virtuous example of zero-kilometre circular economy: waste and slurry are turned into Bio Methane and Bio LNG, which can power commercial and heavy goods vehicles: a fuel with lower emissions, which may even zero emitted CO2.
This technology has evolved to achieve a high level of reliability and is gradually spreading on the market. It enables the maximum reduction of emissions in the WTW cycle, even achieving carbon negativity in some cases, with the saving of natural emissions, from fuel matrices like cattle slurry for example. It is a much cleaner technology than the traditional Diesel engine, enabling a significant reduction of CO2, including on site (-22%), while also almost zeroing fine particles (PM -96%), thus generating significant benefits, also when used in densely populated areas.

As we will see, on site emissions are a factor that makes all the difference.

↑ ADVANTAGES

- **Consolidated technology**
- **Easy and rapid refuelling (BiO-LNG)**
- **Significant autonomies (e.g. BIO-LNG)**
- **Vehicle use modalities similar to traditional diesel**

↓ DISADVANTAGES

- **Scalability of vehicle use limited by the driving power of available engines**
- **Uneven distribution of refuelling points throughout Europe**
- **No large scale availability of Biomethane product.**

Source CNR-IIA

Full Electric.

Zero emissions. Zero noise.

BEV, Battery Electric Vehicle. This acronym indicates 100% electric power, with powertrains that can consist of one, two or even more engines, depending on the models and batteries, which come in different sizes.
It is still in an experimental phase for HGVs and requires unconventional use. The power storage capacity of current batteries limits their use, mostly due to travel autonomy and charging speed. It also requires a different driving technique compared to traditional engines, as well as the planning of routes that takes into consideration autonomy and available charging points.

The first solution available on the market to guarantee zero emissions on site. This is an advantage compared to other engines as it introduces the concept of **heavy proximity transport**, enabling HGVs to even access city centres.

On site emissions (TTW cycle) become zero emissions in the WTW cycle, with charging energy if from renewable sources, hydroelectric, solar, wind, for example. However, the impact over time must be assessed in LCA (Life Cycle Assessment), which depends on the management of raw materials required to make batteries and for their later disposal.
This crucial issue **requires further structuring.**

↑ ADVANTAGES

- **Zero emissions on site Zero noise**
- **Enables circulation in city centres without time and area restrictions**
- **Pleasant drive**

↓ DISADVANTAGES

- **Limited journey autonomy**
- **Long charging times**
- **Insufficient number of charging stations throughout Europe**
- **Low scalability due to power limits at charging points.**

Hydrogen.

The end of the fossil age.

It is still considered an experimental solution, however thanks to research and development to which energy players and automotive behemoths are committing themselves, supported by NRRPs, it is safe to presume it will become the solution of the future.

The heart of this technology is the conversion of chemical energy from hydrogen into electric power, through FCEL application.

Currently this happens by means of a reaction process between hydrogen and oxygen in a fuel cell, which generates electricity. The use of the H2 molecule in a gaseous state, enabled by current technology, ensures sufficient autonomy for services at regional and interregional level, with coverage of a good part of global heavy transport.

It is increasingly seen as the technology of the future, because liquid H2 has the potential to develop and cover the entire heavy transport market, entirely replacing fossil fuels, like diesel.

The technological challenge lies in the generation of renewable hydrogen (usually called green hydrogen), which is generated by renewable energy sources, like photovoltaic, wind and hydroelectric.

Extremely high pressures (gaseous state) and low operating temperatures that are close to absolute zero (in liquid form) mean that this technology is still highly sophisticated and complicated to manage.

↑ ADVANTAGES

- **Zero emissions on site**
- **Zero WTW emissions with use of green H2 (from renewable sources)**
- **Zero noise**
- **Rapid refuelling times**

↓ DISADVANTAGES

- **Experimental technology**
- **Shortage of refuelling points throughout Europe**
- **Low energy efficiency in H2 molecule production (not naturally occurring)**
- **Highly difficult to manage molecules both in liquid and gaseous state**

A summary.

Free to provide the best.

The availability of different green energies for each technology determines its weight in the BEST mix, which will never consist of a single one: it will vary according to the ecosystem and in general reference HGV market of intended application.
The scalability of green energy sources in proximity to heavy transport orients the BEST mix.

THE
ECO-LOGISTICS
REVOLUTION.

Possible scenarios.

To date LC3 operates its own fleet of 200 trucks, approximately 65 % are powered by liquid methane (LNG, BIO LNG, BIO CNG) and 2 % electric BEV. We were the first to believe and invest in this technology as a concrete solution for the ecological transition of road haulage. A trailblazing decision which, according to experts of the sector, constitutes a valid fuel model, a winning choice in the face of climate change that improves air quality.

HVO

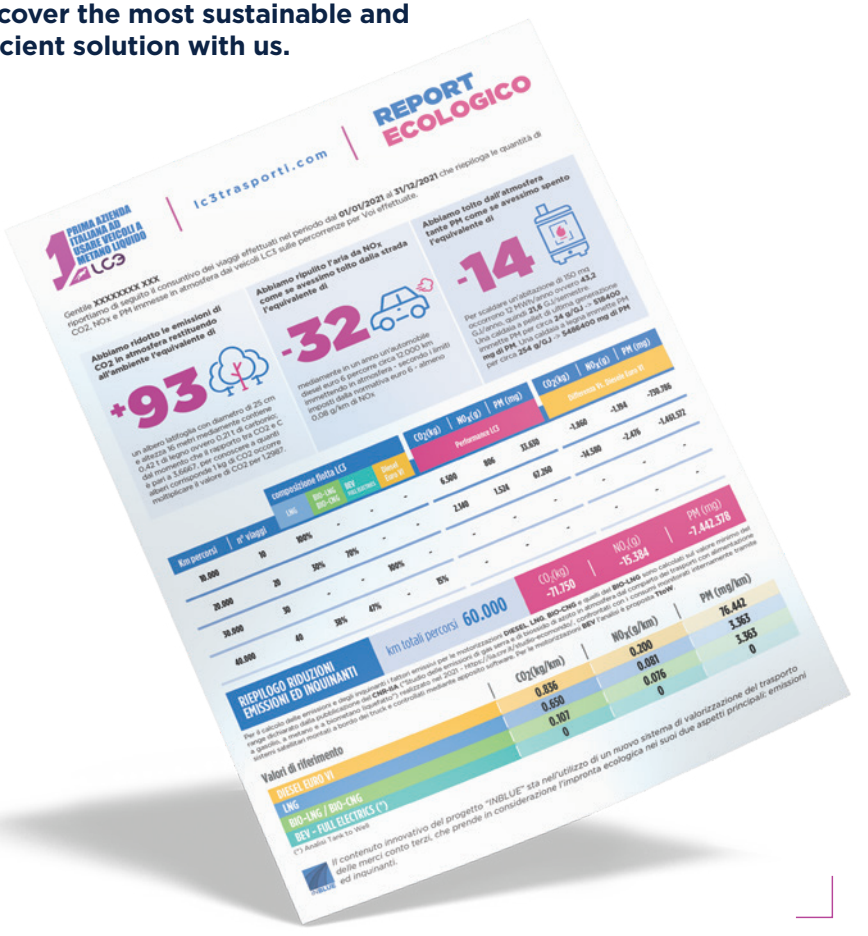
BIO-CNG

BIO-LNG

ELECTRIC

What is the BEST mix for your company?

CHOOSE YOUR SUSTAINABILITY
Discover the most sustainable and efficient solution with us.



Il contenuto innovativo del progetto "INBLUE" sta nell'utilizzo di un nuovo sistema di valorizzazione del trasporto delle merci conto terzi, che prende in considerazione l'impronta ecologica nei suoi due aspetti principali: emissioni ed inquinanti.

What will the fifth pillar be?

The LC3 vision and approach for your heavy transport.

BEST MIX

Powered by

LC3

GUBBIO (PG) | Via Tifernate 204

info@lc3trasporti.com | Tel. 075923611

lc3trasporti.com