



Complementarity and competition between technologies

François Detroux

Business Development Executive, Low carbon mobility

International Conference on Mobility Challenges, 9th December 2021

Energy Solutions Global Business Unit

AGENDA

INTRODUCTION

- ENGIE, LOW CARBON MOBILITY
- LARGE RANGE OF ALTERNATIVE FUELS AND RELATED TECHNOLOGIES
- LIFE CYCLE ANALYSIS IS A MUST HAVE TO MEASURE GREENHOUSE GAS AND LOCAL POLLUTANTS

LIGHT VEHICLES,

- (GREEN) ELECTRICITY IS INCREASINGLY A NO BRAINER
- CAN WE SECURE A 100% SHIFT TOWARDS GREEN BEV?
- ENGIE IS CONTRIBUTING TO THIS TARGET

HEAVY DUTY VEHICLES : LONG TERM AMBITION & ACT TODAY

- BIOGAS IS THE ONLY SOLUTION AVAILABLE TODAY
- NO SINGLE BULLET ON THE LONG TERM?
- EACH ALTERNATIVE FUEL HAS OWN STRENGTHS & WEAKNESSES, THEY COULD COMPLEMENT EACH OTHER
- NEED TO REDUCE GREEN H2/BEV PRICE HANDICAP
- ENGIE IS INVESTING IN BIOGAS, GREEN ELECTRICITY AND GREEN HYDROGEN INFRASTRUCTURE

CONCLUSION : NEED FOR A SEGMENTED APPROACH

QUESTION : HOW TO SECURE BUSINESS MODELS TO ACCELERATE INVESTMENTS?

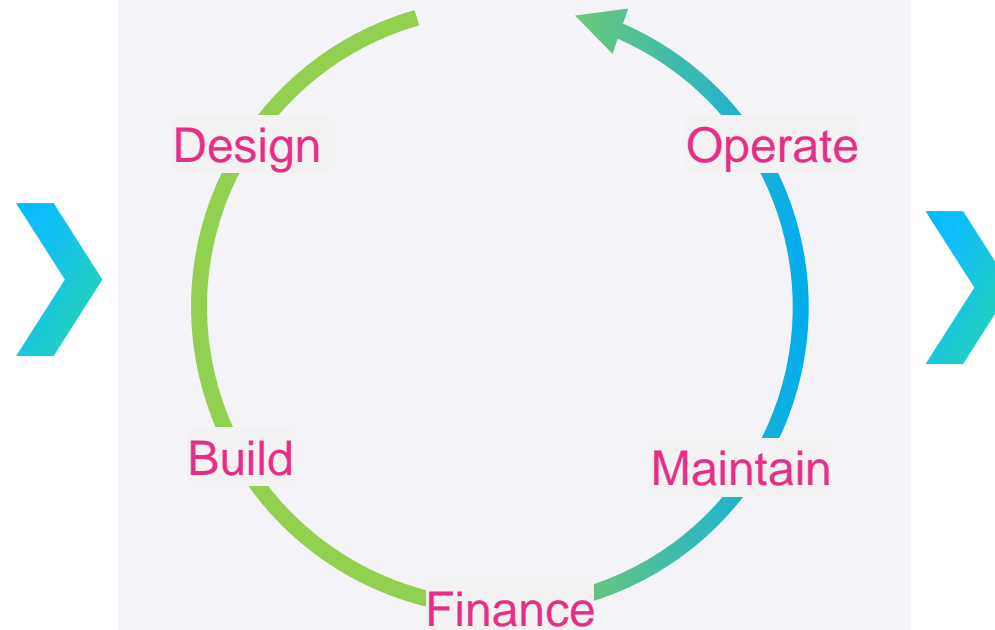
ENGIE PROVIDES CLEAN FUELS INFRASTRUCTURES AND RETAILS THE CLEAN FUELS REQUIRED FOR DECARBONIZATION OF TRANSPORT

Energy production and supply



Energy Solutions Global Business Unit

Clean fuel infrastructure owner and operator



WE SELECTIVELY CAPTURE VALUE ALONG THE VALUE CHAIN

Clean fuel retail and related services



INTRODUCTION: LARGE RANGE OF ALTERNATIVE FUELS... AND RELATED INFRASTRUCTURE TECHNOLOGIES

Illustrations Alternative Fuels	
Gasoline	
Diesel	Diesel / Biodiesel (multiple sources)
LPG	
Gas	Natural Gas
	Biomethane (multiple sources)
	E-methane
Electric	Nuclear
	Wind
	PV
	..
Hydrogen	« Carbonized »
	« Low Carbon » (blue, turquoise, fluo)
	« Renewable » (white, indigo)

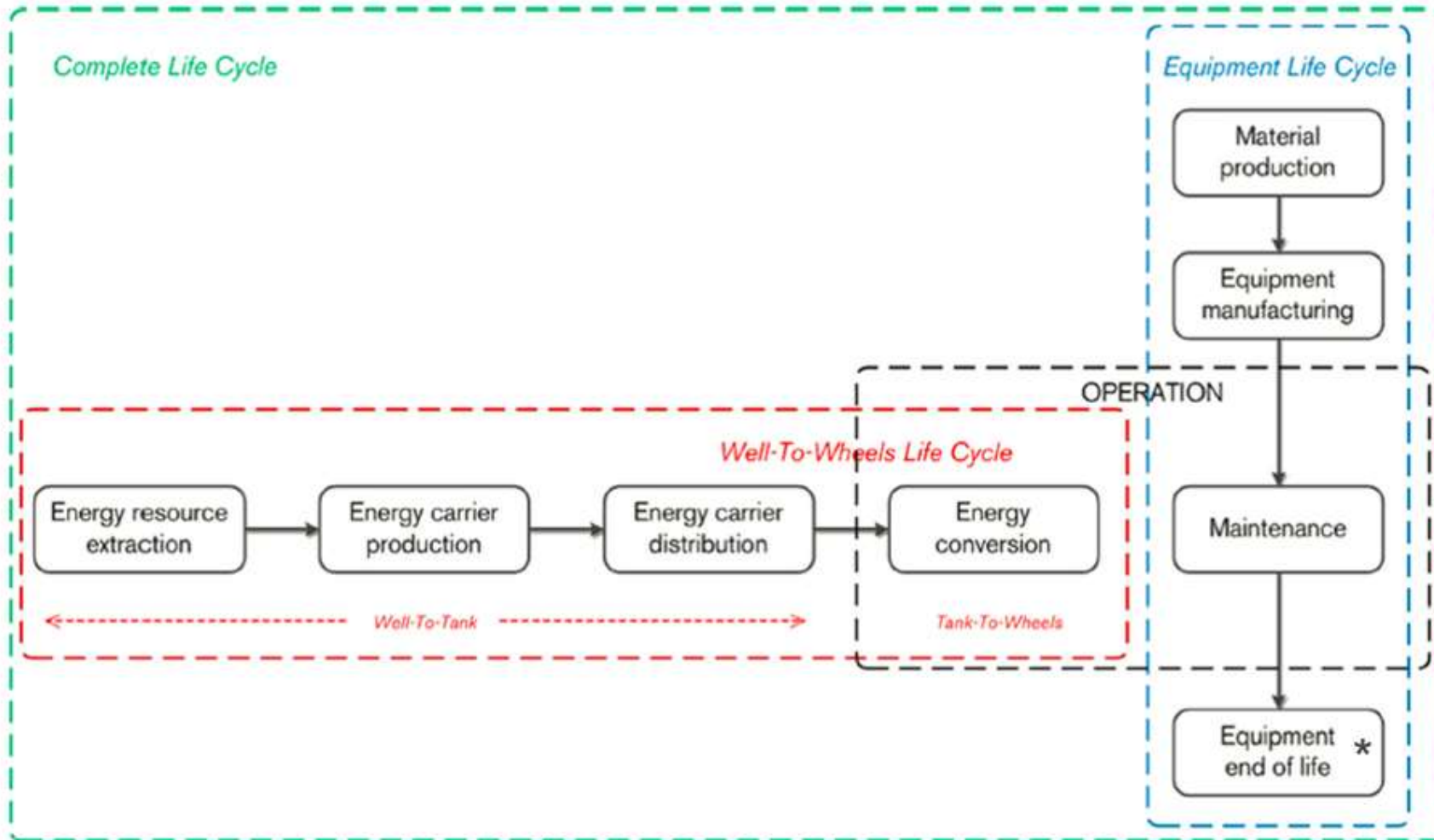
Illustrations Infrastructure Related Technologies	
Gasoline	
Diesel	
Gas	Compressed Natural Gas (CNG)
	Liquid Natural Gas (LNG)
	Liquefied-to-Compressed Natural Gas (LCNG)
Electric	AC
	DC (incl. MCS)
	Pantographs (up and down)
	Electric roads
	Battery swap
Hydrogen	Compressed (350 bars)
	Compressed (700 bars)
	Liquid

SIMPLIFIED VIEW:

- This encompass a great variety of production and transport pathways.
- Blendings are also possible..
- Not exhaustive..

WHICH LT SOLUTION FOR HYDROGEN?

LIFE CYCLE ANALYSIS IS A MUST HAVE TO MEASURE GREENHOUSE GAS AND LOCAL POLLUTANTS



X « Zero emission vehicles »

V Grey hydrogen is worse than diesel

V Biomethane can have up to net positive impact (e.g. Anaerobic Digestion)

V Green electricity, green hydrogen and biomethane have a very positive impact

V but we should first try to travel less, in a smarter and more efficient way (smaller vehicles, public transport,..)

ENERGY SOURCE IS KEY TO CONSIDER..

AGENDA

INTRODUCTION

- ENGIE, LOW CARBON MOBILITY
- LARGE RANGE OF ALTERNATIVE FUELS AND RELATED TECHNOLOGIES
- LIFE CYCLE ANALYSIS IS A MUST HAVE TO MEASURE GREENHOUSE GAS AND LOCAL POLLUTANTS

LIGHT VEHICLES,

- (GREEN) ELECTRICITY IS INCREASINGLY A NO BRAINER
- CAN WE SECURE A 100% SHIFT TOWARDS GREEN BEV?
- ENGIE IS CONTRIBUTING TO THIS TARGET

HEAVY DUTY VEHICLES : LONG TERM AMBITION & ACT TODAY

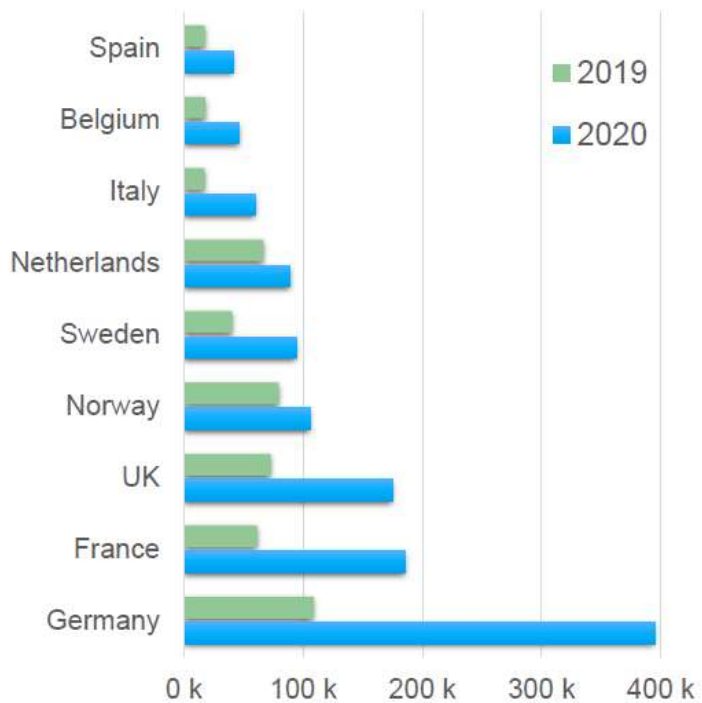
- BIOGAS IS THE ONLY SOLUTION AVAILABLE TODAY
- NO SINGLE BULLET ON THE LONG TERM?
- EACH ALTERNATIVE FUEL HAS OWN STRENGTHS & WEAKNESSES, THEY COULD COMPLEMENT EACH OTHER
- NEED TO REDUCE GREEN H2/BEV PRICE HANDICAP
- ENGIE IS INVESTING IN BIOGAS, GREEN ELECTRICITY AND GREEN HYDROGEN INFRASTRUCTURE

CONCLUSION : NEED FOR A SEGMENTED APPROACH

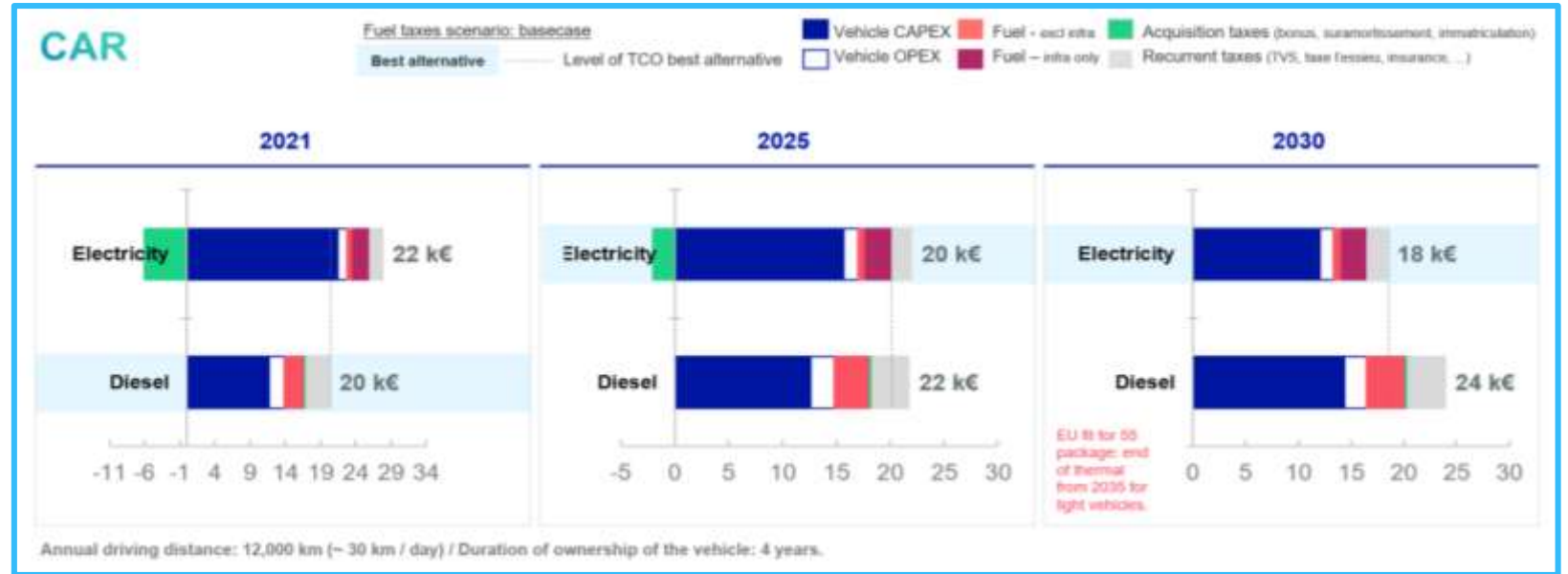
QUESTION : HOW TO SECURE BUSINESS MODELS TO ACCELERATE INVESTMENTS?

LIGHT VEHICLES, ELECTRICITY IS INCREASINGLY A NO BRAINER

Number of new EV registrations in the EU

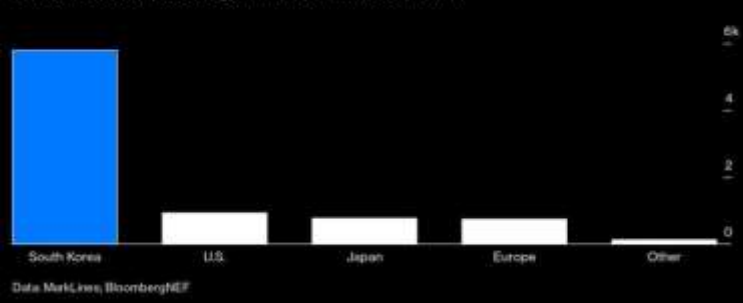


Acceleration of sales



Lower Total Cost of Ownership than diesel (source: ENGIE Impact)

Global sales of passenger fuel-cell vehicles, 2020

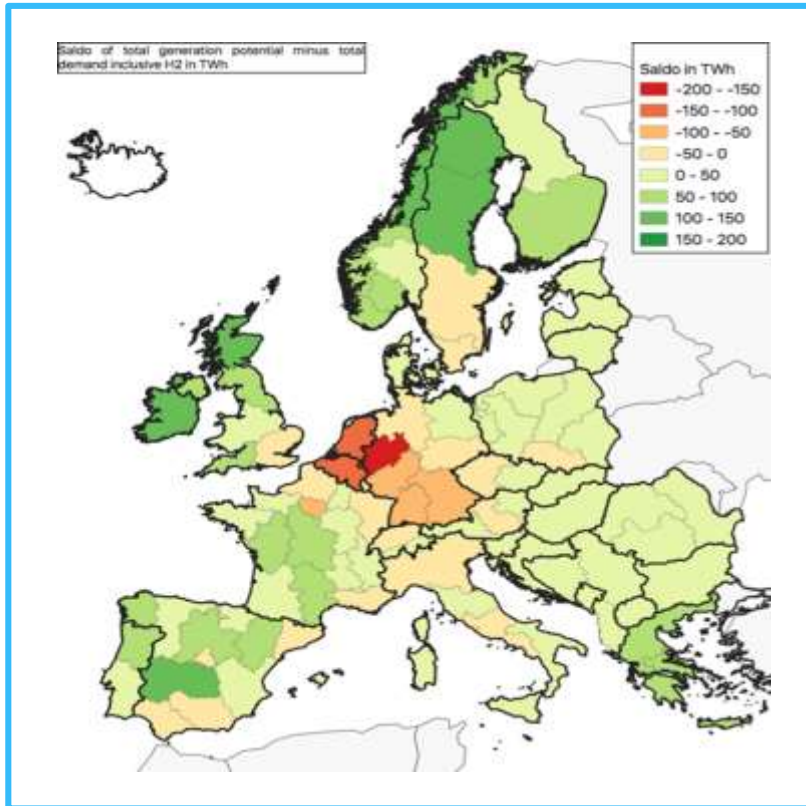


H2: no sales worldwide, will not be needed

- Fit for 55 package (proposal): end of thermal from 2035
- Vehicles OEM's:
 - Electrification: 300 bn\$ investment committed by 2030
 - gas: end of R&D & new models..

Clear consensus from stakeholders

LIGHT VEHICLES, CAN WE SECURE A 100% SHIFT TOWARDS GREEN BEV?



*Is the RES potential sufficient for carbon neutrality in NW-EU?
It is increasingly difficult to find fields and secure permitting.*

Sufficient raw materials ?

Ability to install sufficient chargers in dense urban areas?

Sufficient fast charge parking places and capacity on highways to meet peaks?

Ability from the grid to secure large fleets and rural connections?

Other bottlenecks?

WHAT ARE THE KEY BOTTLENECKS TO BE DEALT WITH?

LIGHT VEHICLES, ENGIE IS CONTRIBUTING TO THIS ELECTRIFICATION TARGET



Global leader in hardware/software solutions



Charging on motorways



Partner of key manufacturers

ENGIE signe la charte « Objectif 100 000 bornes »

Le 12 octobre 2020, **ENGIE** signe la **charte** « Objectif 100 000 **bornes** » du Ministère de la transition écologique, chargé des Transports en présence de Madame la Ministre de la Transition écologique et solidaire et de Monsieur le Ministre délégué chargé des transports. Cet **engagement** s'inscrit dans l'a

Electrification commitments

AGENDA

INTRODUCTION

- ENGIE, LOW CARBON MOBILITY
 - LARGE RANGE OF ALTERNATIVE FUELS AND RELATED TECHNOLOGIES
 - LIFE CYCLE ANALYSIS IS A MUST HAVE TO MEASURE GREENHOUSE GAS AND LOCAL POLLUTANTS
-

LIGHT VEHICLES,

- (GREEN) ELECTRICITY IS INCREASINGLY A NO BRAINER
- CAN WE SECURE A 100% SHIFT TOWARDS GREEN BEV?
- ENGIE IS CONTRIBUTING TO THIS TARGET

HEAVY DUTY VEHICLES : LONG TERM AMBITION & ACT TODAY

- BIOGAS IS THE ONLY SOLUTION AVAILABLE TODAY
- NO SINGLE BULLET ON THE LONG TERM?
- EACH ALTERNATIVE FUEL HAS OWN STRENGTHS & WEAKNESSES, THEY COULD COMPLEMENT EACH OTHER
- NEED TO REDUCE GREEN H2/BEV PRICE HANDICAP
- ENGIE IS INVESTING IN BIOGAS, GREEN ELECTRICITY AND GREEN HYDROGEN INFRASTRUCTURE

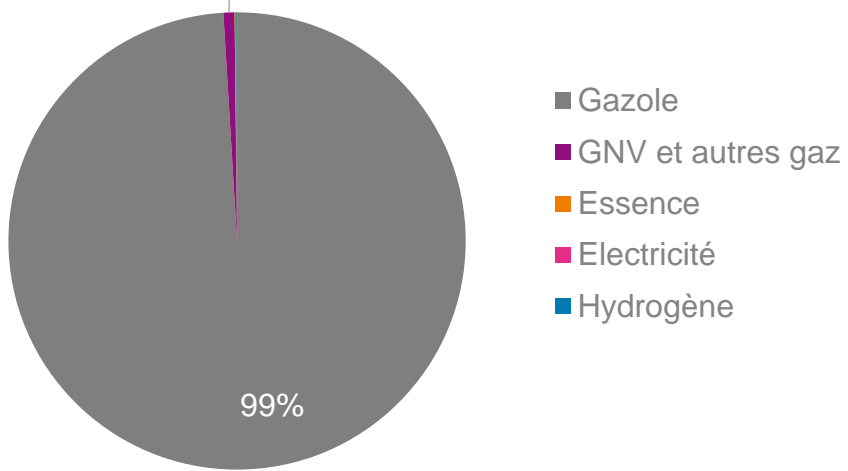
CONCLUSION : NEED FOR A SEGMENTED APPROACH

QUESTION : HOW TO SECURE BUSINESS MODELS TO ACCELERATE INVESTMENTS?

HEAVY DUTY VEHICLES, (BIO)GAS IS THE ONLY SOLUTION AVAILABLE TODAY

Heavy duty fuel mix (2020)

Source: SDES

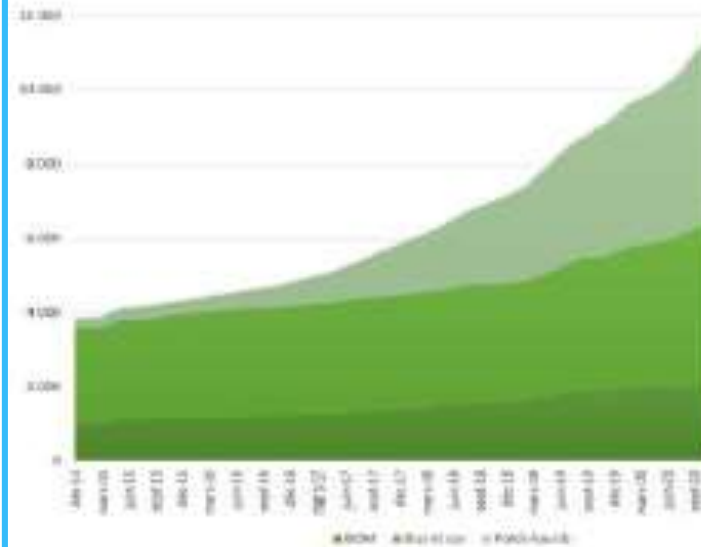


- No 44t BEV or H2 truck available for sale before 2024, lack of infrastructure
- Total Cost of Ownersip
- ..

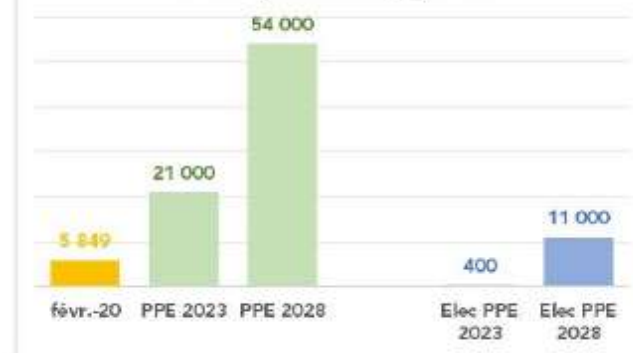
No alternative on the market

NEED TO ACT TODAY!

Evolution du parc de véhicules lourds GNV en France



PL GNV (nb immat), yc BOM



Strong growth, aligned with PPE target

LE GAZ NATUREL

LA SOLUTION
VERS LA DÉCARBONATION
DU TRANSPORT ROUTIER

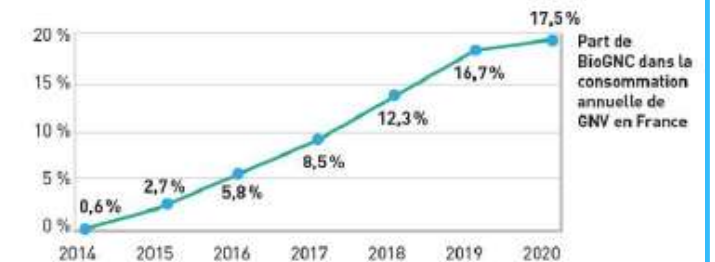


DE RÉDUCTION DES ÉMISSIONS DE CO₂
GRÂCE AU BIO-MÉTHANE (PUIXS À LA ROUE)



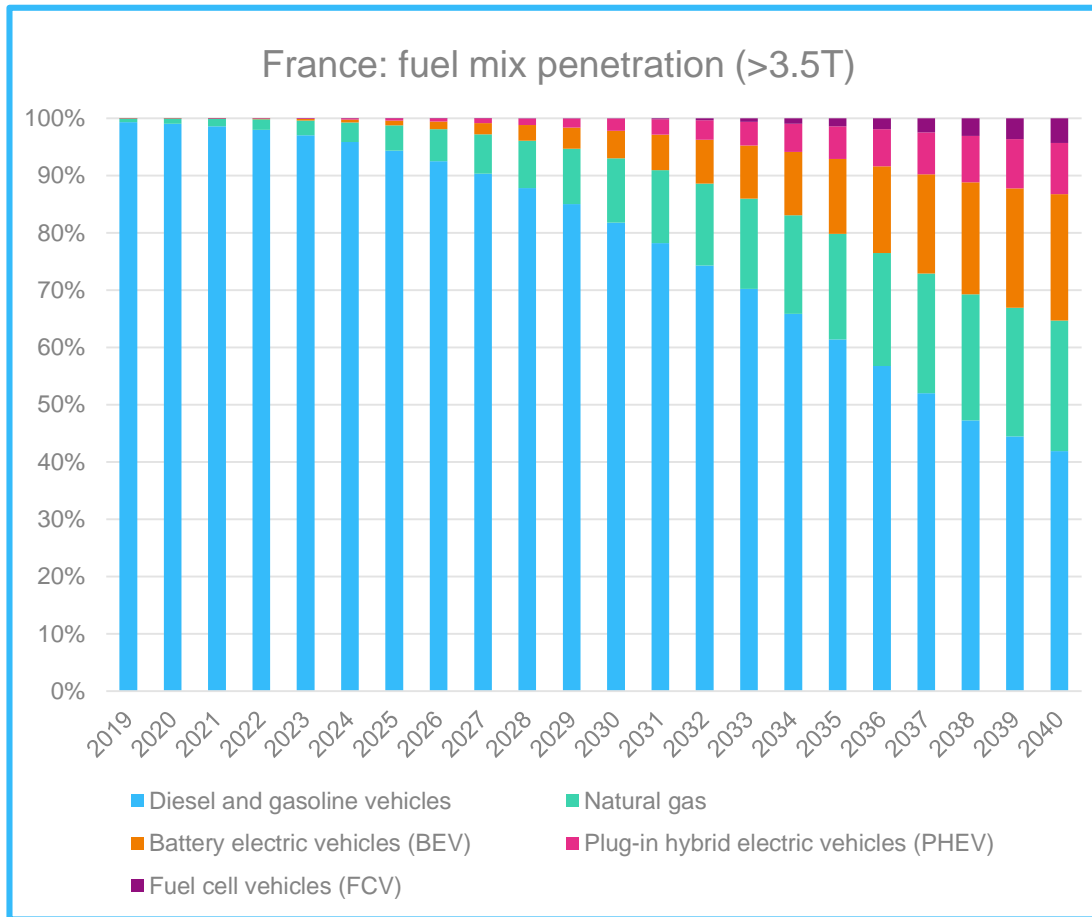
100 % RENOUELABLE
CRÉATEUR D'ÉCONOMIE
CIRCULAIRE

17,5 % DE BIOGNC DANS LA CONSOMMATION FRANÇAISE DE GNV

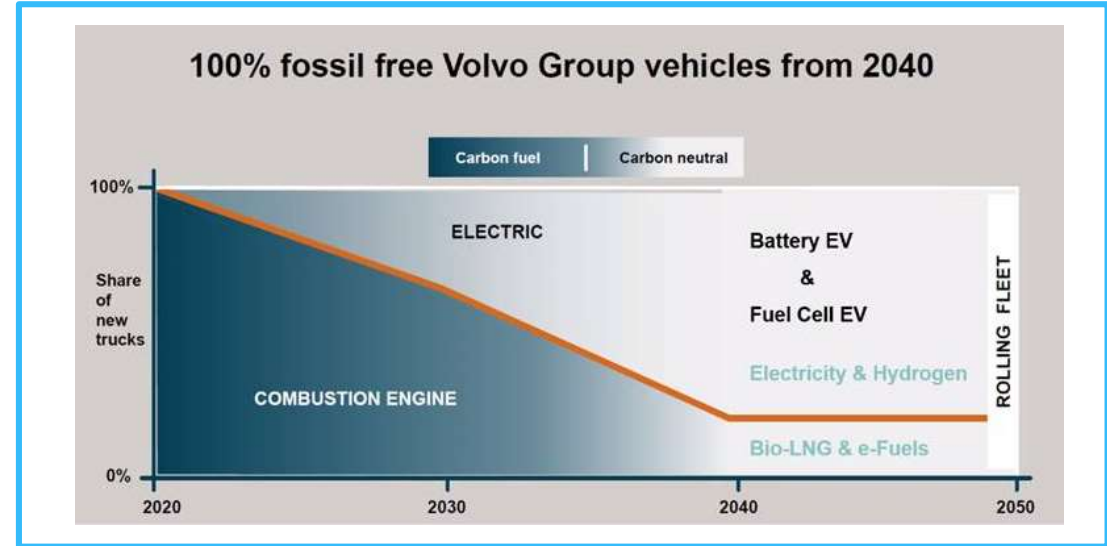


No shame..

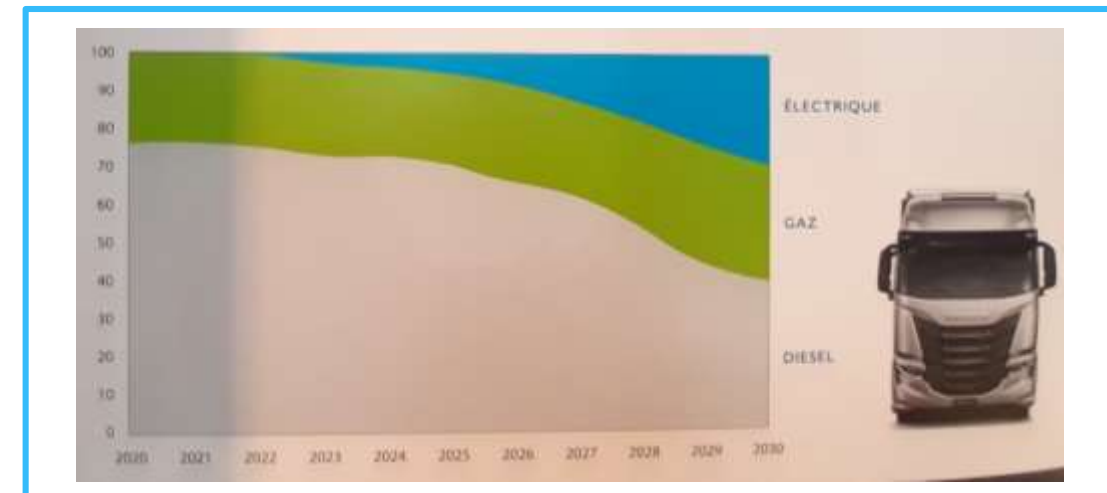
HEAVY DUTY VEHICLES, NO SINGLE BULLET ON THE LONG TERM?



Source BNEF



Source VOLVO



Source IVECO

CONVENTIONAL FUELS ARE OMNIPRESENT,
LARGE MARKET AVAILABLE FOR ALL.

EACH HAS OWN STRENGTHS AND WEAKNESSES

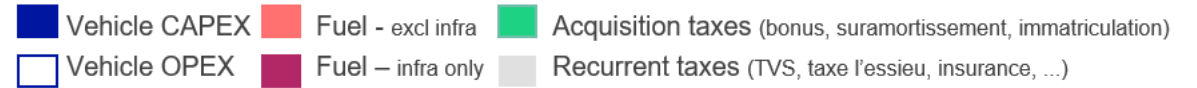
	Biogas	Electric	Green Hydrogen
MATURITY (infra, vehicles,..)	V	X	X
LIMITATIONS OF RESSOURCES	X	X	X
TOTAL COST OF OWNERSHIP	V	X	X
CO2	V	V	V
LOCAL POLLUTANTS (FRANCE)	~	V	V
OPERATIONAL CONSTRAINTS (charging time, payload, travel range..)	~	X	~

THEY COULD COMPLEMENT EACH OTHER.

HEAVY DUTY VEHICLES, NEED TO REDUCE GREEN H2/BEV PRICE HANDICAP

Fuel taxes scenario: basecase

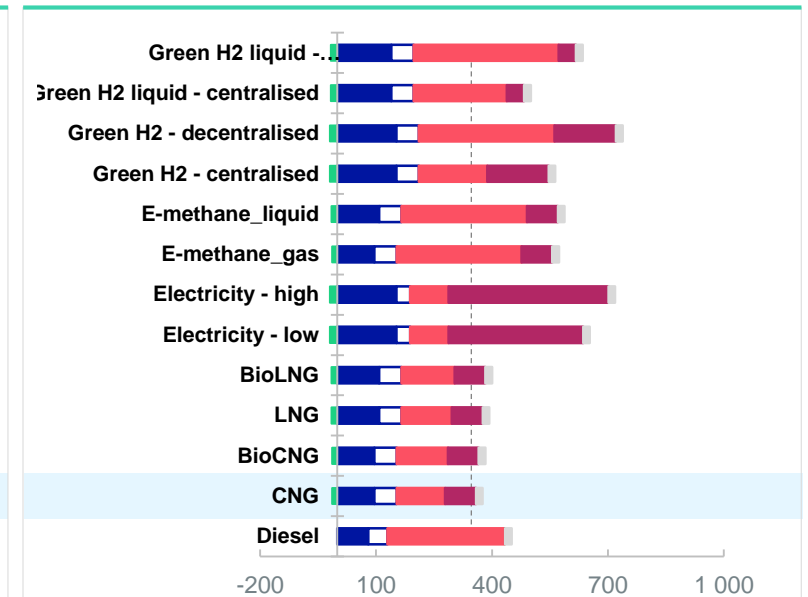
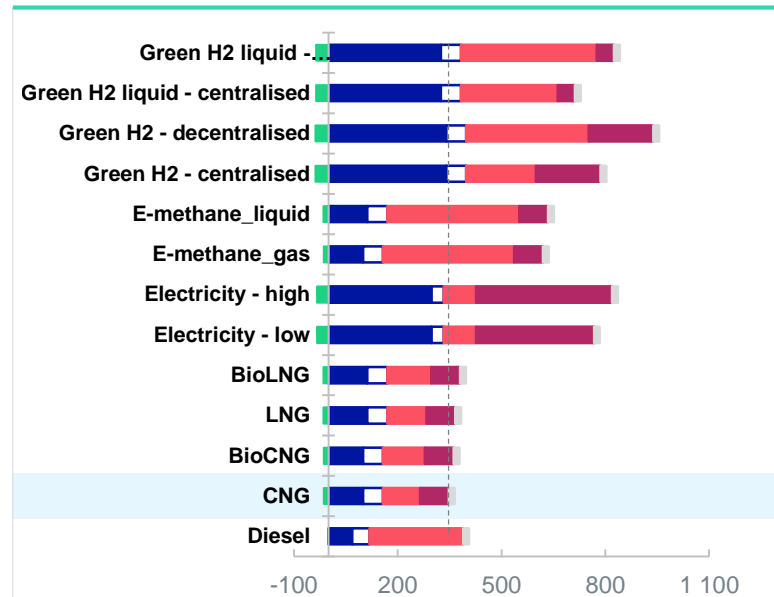
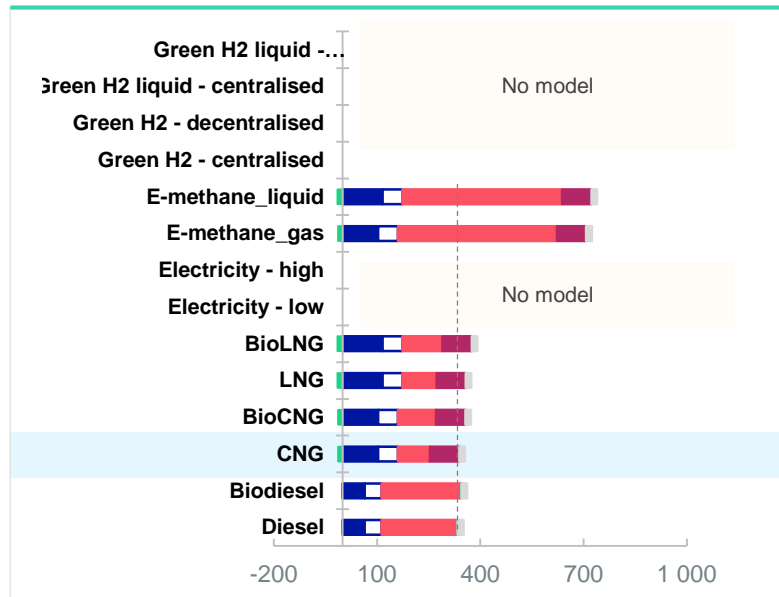
Best alternative ----- Level of TCO best alternative



2021

2025

2030



Annual driving distance: 110,000 km (~ 500 km / day assuming 220 days of operation) / Duration of ownership of the vehicle: 7 years.

NB: Considering daily routine constraint (i.e autonomy of BEV lower than daily needs), Overnight + opportunity charging.

*payload estimated

	TCO k€	Payload	TCO €/t/km
Diesel	450	28.5	0.14
CNG	362	28.5	0.12
Elec	634	16	0.36
H2-gaseous	545	26	0.19

HEAVY DUTY VEHICLES, ENGIE IS INVESTING IN THE FUTURE

Gas



France
+ Italy, Belgium, Romania, Mexico,
Ivory Coast..

Electric



Europe/Global

Hydrogen



France/Global



But also..

AND ALREADY A LEADER IN FRANCE

Gas

140 stations, 250+ carriers under contract with ENGIE Solutions



ENGIE Solutions (Bio)NGV public stations for HDV's

Electric

Partnerships with major OEM's

Partner for electrification
13 countries



Partner for electrification
6 countries



Hydrogen

Hydrogen stations operated by
ENGIE



Territorial Projects



CONCLUSION: NEED FOR A SEGMENTED APPROACH

LARGE RANGE OF ALTERNATIVE FUELS AND RELATED TECHNOLOGIES

LIFE CYCLE ANALYSIS IS A MUST HAVE TO MEASURE GREENHOUSE GAS AND LOCAL POLLUTANTS

LIGHT VEHICLES, (GREEN) ELECTRICITY IS INCREASINGLY A NO BRAINER

- CAN WE SECURE A 100% SHIFT TOWARDS GREEN BEV?
-

HEAVY DUTY VEHICLES : LONG TERM AMBITION & ACT TODAY

- BIOGAS IS THE ONLY SOLUTION AVAILABLE TODAY
 - NO SINGLE BULLET ON THE LONG TERM?
 - EACH ALTERNATIVE FUEL HAS OWN STRENGTHS & WEAKNESSES, THEY COULD COMPLEMENT EACH OTHER
 - NEED TO REDUCE GREEN H2/BEV PRICE HANDICAP
-

ENGIE, LEADER IN FRANCE, IS BUILDING TODAY, THE LOW CARBON MOBILITY ECOSYSTEMS OF TOMORROW.

QUESTION: HOW TO SECURE BUSINESS MODELS TO ACCELERATE INVESTMENTS?

FOR BIONGV:

- SECURE LT PUBLIC SUPPORT, INCREASE TRAVEL RANGE (CNG) & SUPPORT BIOMETHANE PRODUCTION,..

FOR EV/GREEN H2:

- REDUCE PRICE HANDICAP, IMPROVE MATURITY, ALIGN VISION AND FEDERATE STAKEHOLDERS,..

FOR ALL:

- INCENTIVIZE CHANGE,..



ENGIE PROVIDES CLEAN FUELS INFRASTRUCTURES AND RETAILS THE CLEAN FUELS REQUIRED FOR DECARBONIZATION OF TRANSPORT

ENGIE 2021

AMBITION
2025

(BIO)NGV STATIONS	# 1 (FRANCE)	140	200
EV CHARGERS	# 2 (WORLDWIDE, excl. China)	300.000 (RETAIL & INSTALLATION)	TO BE CONFIRMED (<u>OWNED & OPERATED</u>)
(GREEN) H2 REFUELING STATIONS	# 4 (EUROPE)	9	50

ENGIE IS ACTIVE ON THE ALTERNATIVE FUELS MIX

Inner City
Passenger cars, utility vans

Electricity

Last mile
Utility vans, delivery trucks, bus

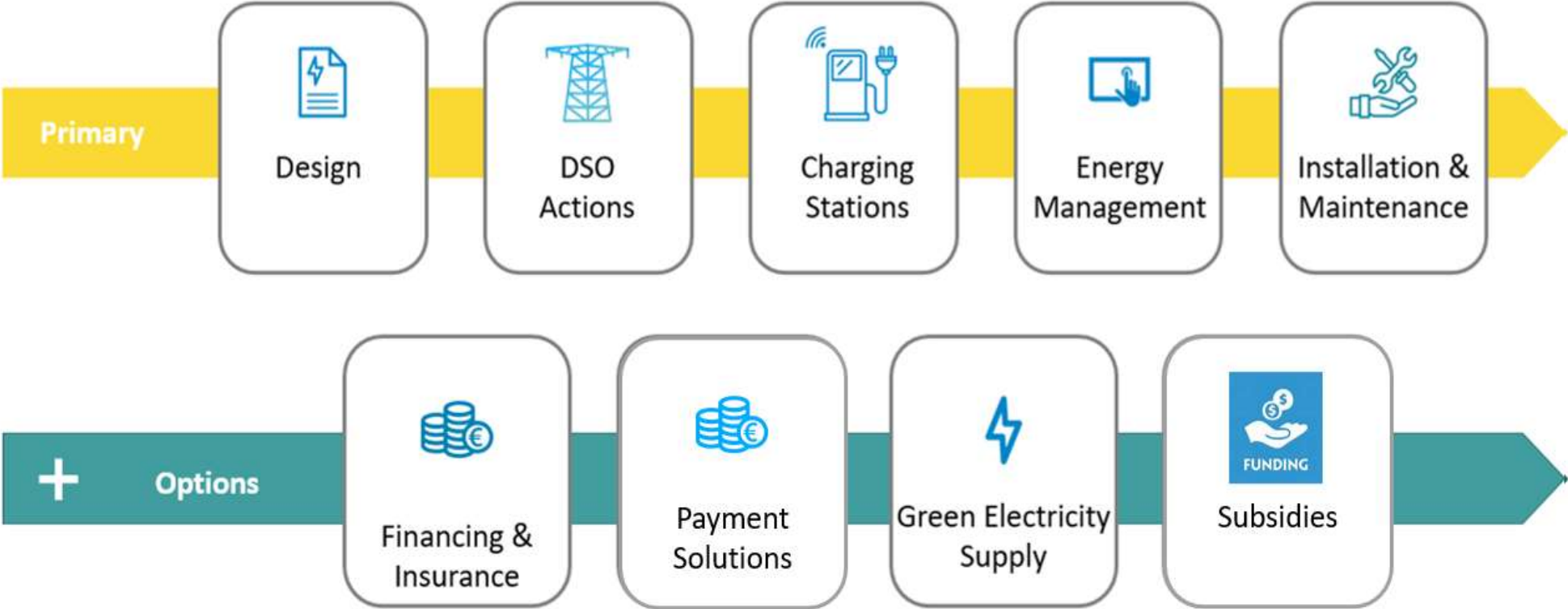
Electricity, (bio)CNG, (green)H₂

Long range
Trucks, bus, rail, maritime

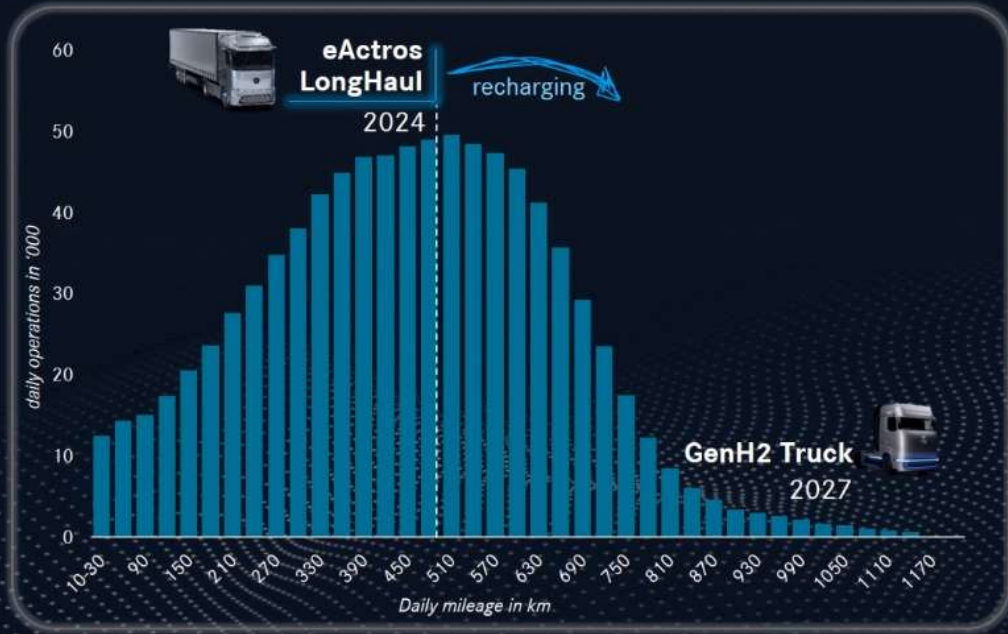
(bio)LNG, (green)H₂



DELIVERING UP TO END-TO-END SOLUTION



TRIPS OF ABOUT 700 KM ARE POSSIBLE IF RECHARGING IS INCLUDED IN THE DAILY OPERATIONS



- Range**
Technology development
- Payload**
Requirements
- Flexibility in operations**
Infrastructure and charging

