



**Intelligence**  
Briefing ■

**IRU Green Compact**  
**Research Study: Europe**  
Executive Summary

December 2023

## Getting to 2050

Commercial road transport is the lifeblood of economies and communities, moving people and goods across continents or across town.

This flexibility has made road transport a vital ingredient for economic prosperity and social harmony in all countries.

For over a century, the sector has served people primarily using fossil diesel fuel, in trucks, buses and coaches with internal combustion engines.

This is now changing.

The global sector has committed to become fully carbon neutral by 2050, in line with national and international targets.

But it is an enormous job.

Changing hundreds of millions of vehicles, operational practices and infrastructure – without harming the mobility and logistics that people depend on – needs a pragmatic evidence-based approach, implemented with the industry and its regulators, suppliers and users.

This is the IRU Green Compact.

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# 1. Introduction

The global commercial road transport industry has committed to become carbon neutral by 2050 via the IRU Green Compact.

The Green Compact is driven by evidence, testing, sharing results and scaling up with the industry and its public and private sector partners.

The first major Green Compact research project was conducted in 2023, examining the cost, practicality and results of different decarbonisation scenarios in Europe.

This executive summary provides an overview of this research, focused on the scenarios assessed and a recommended way forward.

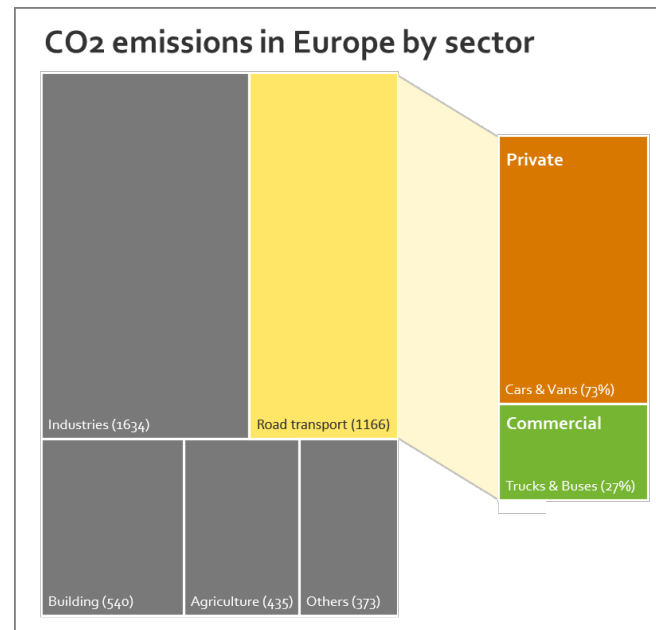
**In short, what is the best, least disruptive and most cost-effective approach to make commercial road transport carbon neutral in Europe by 2050, allowing road transport to continue serving economies and societies?**

## 2. The decarbonisation challenge

The global community, regional bodies and most countries have targets to address climate change by reducing CO<sub>2</sub> emissions.

The European Union has legislated a target to achieve net-zero emissions in all sectors by 2050. Many other European countries have done the same.

An interim EU target and related policy measures seek to reduce CO<sub>2</sub> emissions by 55% by 2030, compared to 2021 levels.



In Europe, road transport emits 28% of greenhouse gas emissions, most of which is from private cars.

Commercial collective road transport with medium- and heavy-duty vehicles (over 3.5 tonnes) emits one quarter of that.

## 2. The decarbonisation challenge

At the same time, commercial road transport demand will continue growing in Europe, at least 50% more tonne-kilometres (tkm) and 25% more passenger-kilometres (pkm) by 2050.

### Commercial road transport is an essential service

In the EU, 77.3% of goods transport (tkm) is carried by road (2018), rising to more than 90% of goods when measured in monetary terms. Almost all multimodal supply chains involve truck transport at some point.

In addition, 37.9% of all EU collective passenger mobility (including air, sea and rail) is carried by road (2018).

The wide diversity of commercial road transport services, especially for trucks and coaches over longer distances, is currently dependent on diesel, a carbon intensive fossil fuel, due to its affordability and versatility.

### Commercial road transport is a responsible sector

Innovation from within the sector has driven significant progress over recent decades, for example on increasing safety and reducing NOx emissions.

The sector's challenge now – together with its regulators, suppliers and users – is to decarbonise as effectively and efficiently as possible to achieve net-zero emissions by 2050, while at the same time, continuing to serve the people, communities and businesses that depend on it.

### In short, how do we keep people and goods moving while emitting less?

Sources: European Commission 2023

# 3. The IRU Green Compact

IRU and its members, the voice of 3.5 million commercial road transport operators globally, have adopted the Green Compact, a collective commitment and pragmatic roadmap to make the sector carbon neutral by 2050.

The Green Compact researches, tests, shares and scales up operational solutions to decarbonise commercial road transport as effectively, rapidly and efficiently as possible, while continuing to meet increasing demand for passenger and goods road transport services.

## Many solutions are needed to cut CO<sub>2</sub> emissions across the sector

Commercial road transport has a huge diversity of truck, bus and coach services across multiple geographies and distances, and for multiple uses.

The Green Compact therefore covers five pillars of action: alternative fuels; efficient logistics, vehicles and drivers; and collective mobility.

## Countries have vastly different transport and energy landscapes

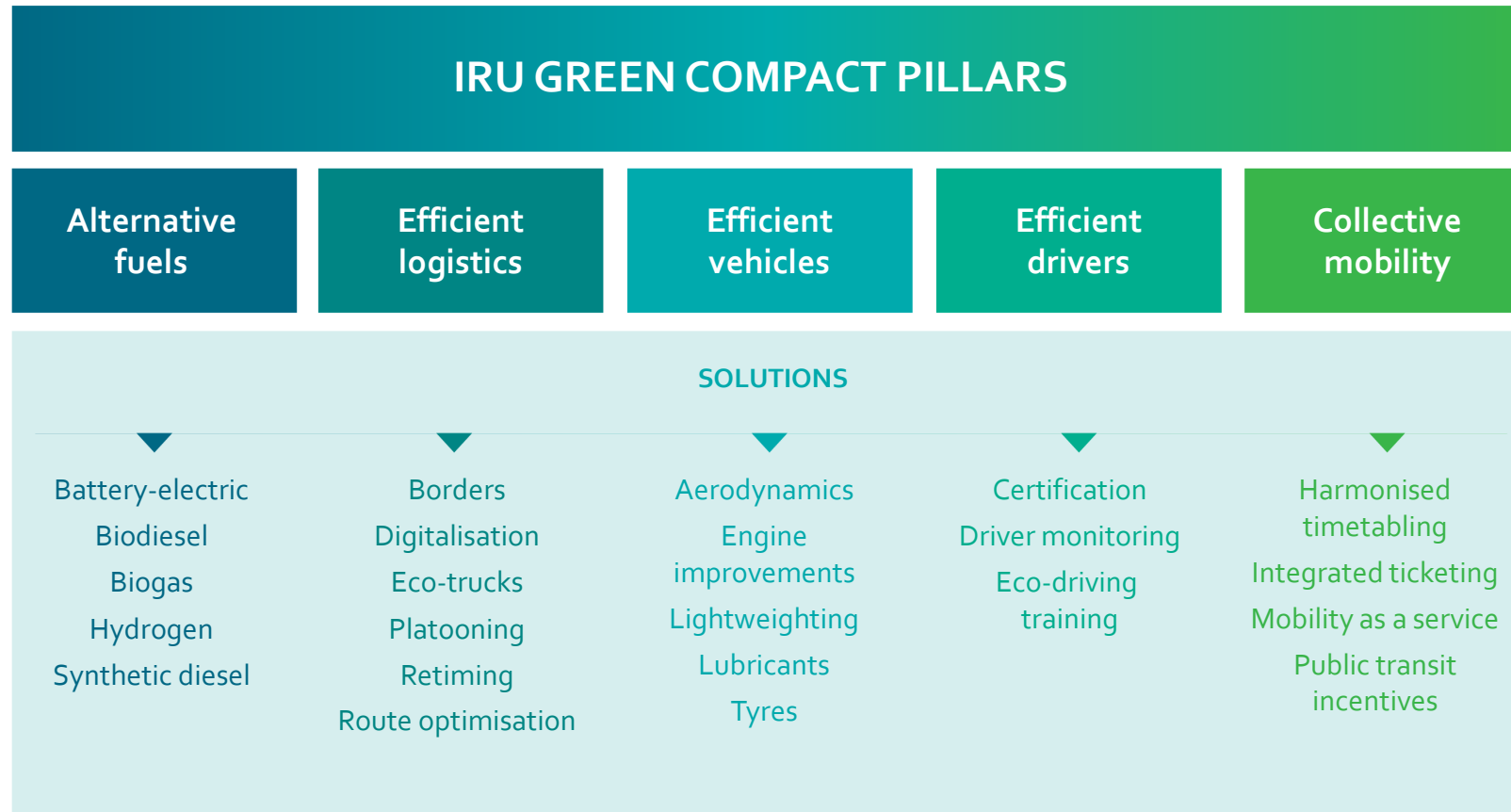
The Green Compact is built on a comprehensive flexible framework,

factoring in transport demand, infrastructure and geography; the sources, production and availability of primary energy and alternative fuels; the structure and resources of the transport sector; and the overall economic and social development of the country.

The Green Compact is based on a well-to-wheel approach to ensure CO<sub>2</sub> emissions from energy production and distribution are factored in. The more limited tank-to-wheel approach only counts CO<sub>2</sub> emissions generated at the vehicle itself as it is operated.

### 3. The IRU Green Compact

## Many solutions are needed to decarbonise commercial road transport





## 4. New research

The IRU Green Compact is based on an evidence-led approach. This includes researching scenarios, testing new approaches, sharing best practices, scaling up proven solutions and monitoring progress through to 2050.

While much research has been conducted into approaches to decarbonise private transport, notably cars, much less has been done for trucks, buses and coaches.

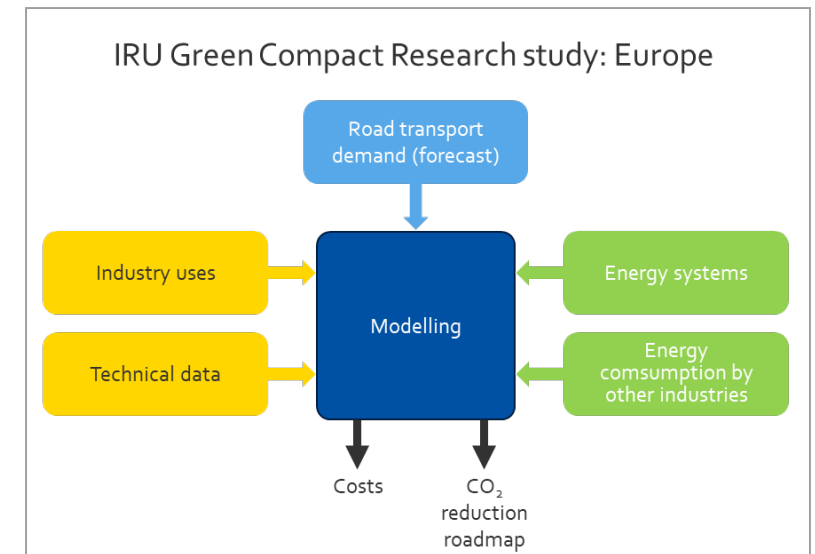
This first major Green Compact research project was conducted in 2023, covering the EU as well as the

Balkans, Iceland, Moldova, Norway, Switzerland and the UK.

### Modelling energy

The research project was based on an energy system modelling that considered energy needs from other industries, as well as logistics optimisation modelling, transport demand, an inter-modality model, and a driver training model.

The research results were independently verified by the Graz University of Technology in Austria.



## 4. New research

Three scenarios to fully decarbonise commercial road transport by 2050 were assessed, based on emissions reduction potential, impact on transport services and investment.

All three scenarios include different mixes of electricity, hydrogen and carbon-neutral bio and synthetic fuel fleets over time.

### Three scenarios

**1. Hydrogen Push** – this scenario assumes a concerted political, financial and industrial effort to boost the use of hydrogen, based on a greater availability of economically

viable clean hydrogen fuel thanks to generous financial subsidies.

**2. Heavy Electrification** – this scenario assumes political will, public policy and financial capacity to prioritise electrification, and clean electricity supply from renewable sources, such as solar and wind, is increased.

**3. Efficiency Focus** – this scenario assumes a focus on maximising the use of proven efficiency measures through to 2050, accelerating energy efficiencies in the shorter term allowing more time to phase in alternative fuels over the longer term.

### Key research assumptions

- Net zero system-wide CO<sub>2</sub> emissions in Europe by 2050, with 55% by 2030 (current EU policy)
- Well-to-wheel CO<sub>2</sub> emissions fall to zero by 2050 (ie including CO<sub>2</sub> emitted in the production and distribution of the energy)
- Single transport CO<sub>2e</sub> price for Europe starting at €45/tCO<sub>2</sub> until 2028, then converging towards the CO<sub>2</sub> pricing trajectory of the IEA net-zero emissions scenario
- Minimum infrastructure targets delivered as per the EU's Alternative Fuels Infrastructure Regulation (AFIR) (status at 3 May 2023)
- Transport demand (goods and passenger) grows at the same rate as GDP/capita forecasts

## 4. New research

### Which scenario is best?

The research assessed each of the three scenarios on:

- How much CO<sub>2</sub> can be removed from the overall system?
- How much future growth in transport service demand (passenger and goods) can be supported?
- What is the cost (private spending on new vehicles, private and public spending on charging/refuelling infrastructure, public spending on power generation and distribution)?

Based on these three criteria, calculated on a cumulative basis from 2018 to 2050, the **Efficiency Focus scenario** is the most effective, least disruptive and most cost-effective scenario to make European commercial road transport carbon neutral by 2050.

### Smarter investment

Decarbonisation requires enormous investments by both the public and private sector.

The Energy Focus scenario is significantly more cost effective,

for both governments and transport businesses.

### A cheaper way to cut CO<sub>2</sub> emissions

Hydrogen Push	€ 1.41 /kg CO <sub>2</sub> e
Heavy Electrification	€ 1.28 /kg CO <sub>2</sub> e
Efficiency Focus	€ 1.06 /kg CO <sub>2</sub> e

*Total cost to remove one kilogram of CO<sub>2</sub> equivalent, cumulatively to 2050, including operator investment in new vehicles, charging and refuelling infrastructure, and public investment in electricity grid capacity.*

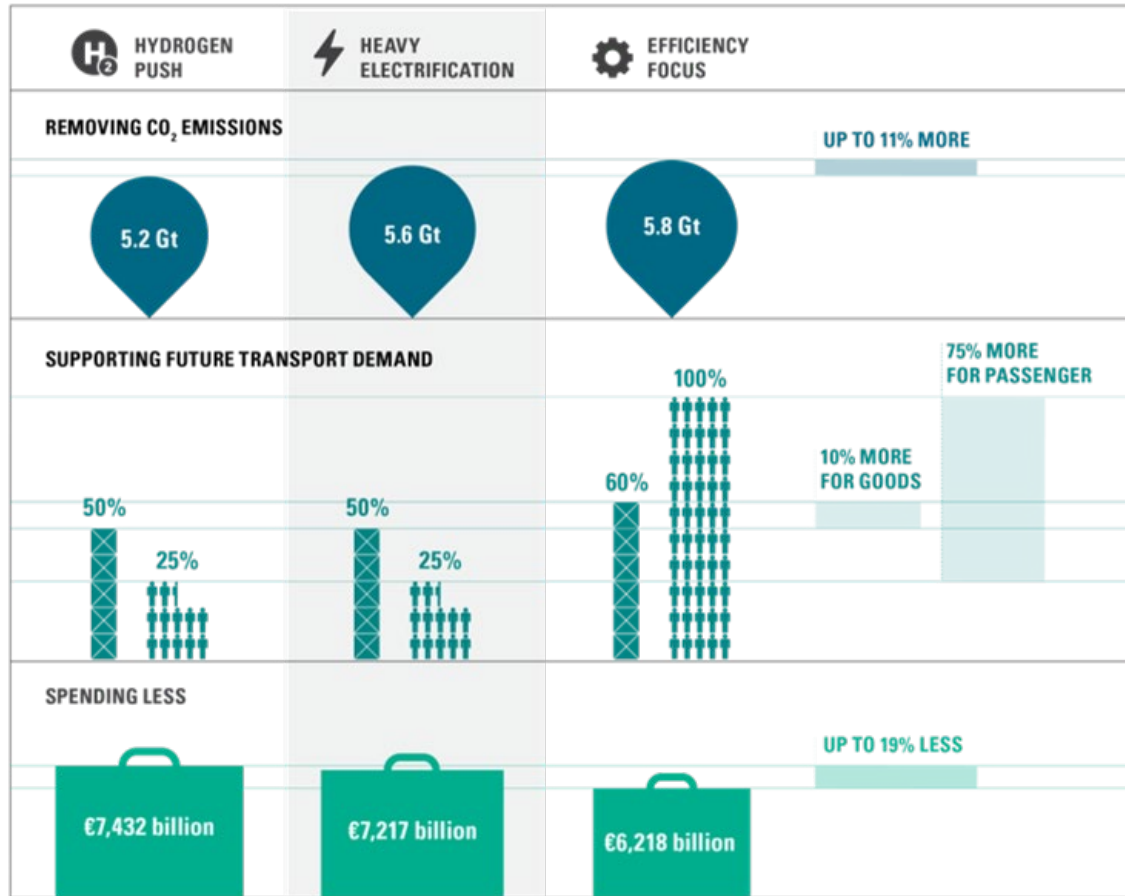
# A focus on energy efficiency is more cost-effective

Including private and public sector investment cumulatively to 2050, the Efficiency Focus scenario costs €1.06 to remove one kilogram of CO<sub>2e</sub>, compared to €1.28 for the Heavy Electrification scenario and €1.41 for the Hydrogen Push scenario.

1.06 €/kg

## 4. New research

# The Efficiency Focus scenario cuts more CO<sub>2</sub>, allows more transport and is cheaper



The Efficiency Focus scenario is up to **11% more effective** in removing CO<sub>2</sub> emissions from commercial road transport compared to the other two scenarios, due to an immediate focus on efficiency measures with existing powertrains, continuing with the steady operational implementation of alternative fuels powertrains through to 2050.

The Efficiency Focus scenario causes **less disruption** to economic growth and social inclusion because it allows more future transport demand to be fulfilled: **10% more goods** transport and **75% more passenger** transport compared to the other scenarios.

The Efficiency Focus scenario **costs up to 19% less** for governments and business; in other words, a saving of at least €1 trillion through to 2050.

# A focus on energy efficiency reduces investment needs

A parallel focus on energy efficiency and alternative fuels is between 16 and 19% more cost-effective for public and private sector investment for the industry to reach net zero emissions by 2050.

19%

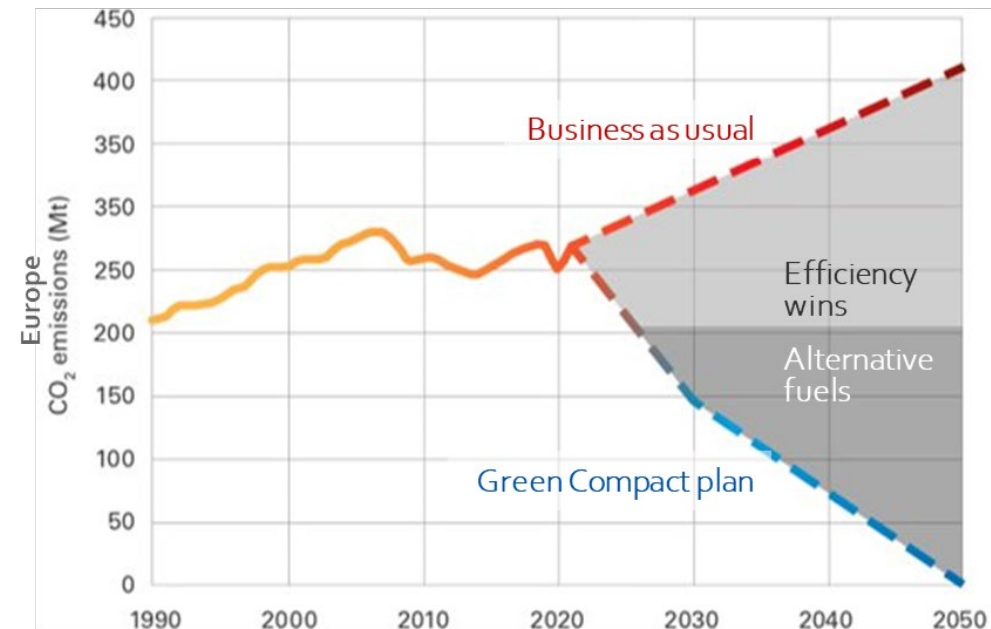
## 5. The way forward: A duplex strategy

This research shows that a focus on implementing energy efficiency measures will cut more CO<sub>2</sub>, be less disruptive as more transport demand can be met, and cost less.

To achieve carbon neutrality by 2050 with this scenario, the sector – in collaboration with governments, suppliers and users – needs to deliver **two types of actions at the same time**: energy efficiency measures and alternative fuels implementation.

One type of action alone will not achieve carbon neutrality by 2050; both levels are needed. This is the duplex strategy.

Commercial road transport CO<sub>2</sub> emissions (well-to-wheel)



## 5. The way forward: A duplex strategy

### Level 1: Energy efficiency

Decoupling energy consumption from transport demand allows the sector to focus more intensively on making logistics, vehicles and drivers more energy efficient.

Across all transport types and powertrain technologies, efficiency gains build on the sector's current best practices, using proven technologies and solutions that avoid disrupting essential transport services.

The roadmap targets efficiency measures in three key areas: the

overall logistics system, vehicles and drivers. These represent three pillars of IRU's Green Compact.

The sector and its partners should continue to research, refine and scale up efficiency solutions as technologies, best practices and transport use patterns evolve to 2050, enabled by a good regulatory framework.

Over time, efficiency measures will also reduce the volumes needed of more expensive alternative fuels for services operated with those vehicles.

This roadmap allows expensive development and infrastructure investment for electricity and hydrogen to be spread over a longer time.

Efficiency measures are estimated to account for 51% of CO<sub>2</sub> emission reductions by 2050.

**51%** of the CO<sub>2</sub> emissions reductions to make the sector carbon neutral by 2050 can be achieved with efficiency measures



## 5. The way forward: A duplex strategy

### Level 2: Alternative fuels

The second level of action is focused on building a robust, practical and economic transition to alternative fuels.

This includes investing in fossil-free alternative fuels, including electricity, hydrogen and biofuels, as well as the public and private infrastructure, vehicles and operational practices needed to use them.

With current legislation, fossil diesel will be progressively phased out from the European fleet around 2040 for trucks and 2050 for buses and coaches.

Electricity is likely to play a key role over the long term to 2050 in many European countries, as well as hydrogen for heavier loads over longer distances.

However, zero- and low-carbon fuel technology options need to remain available and economically viable due to the wide range of commercial road transport service types and needs, and the wide range of energy supply options and restrictions for countries across Europe.

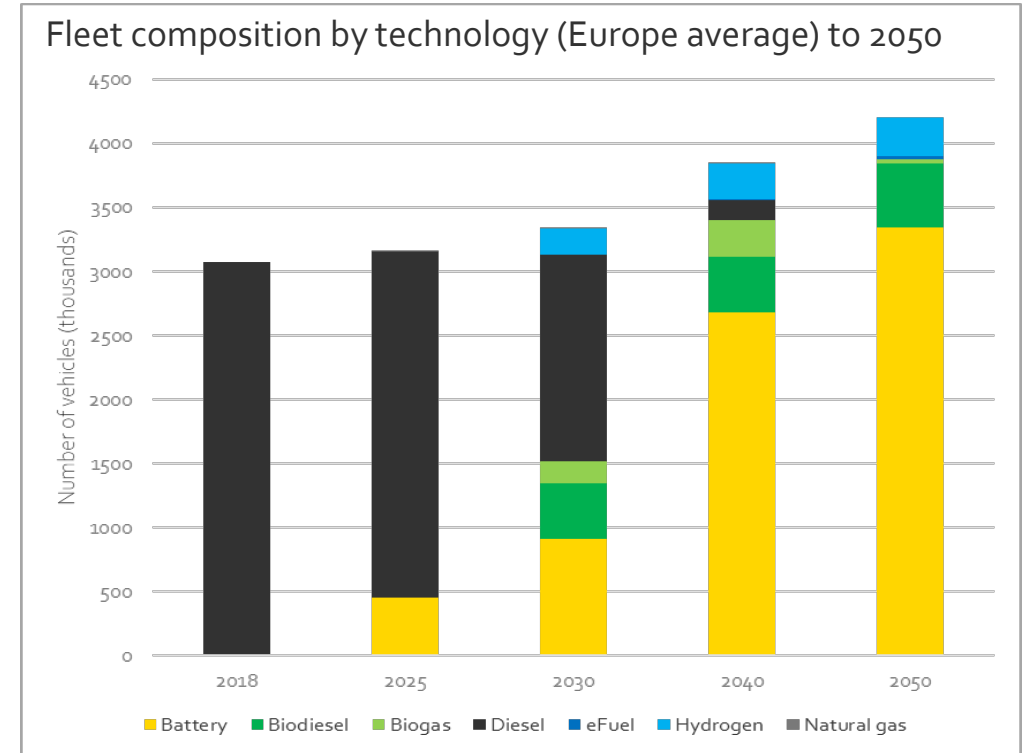
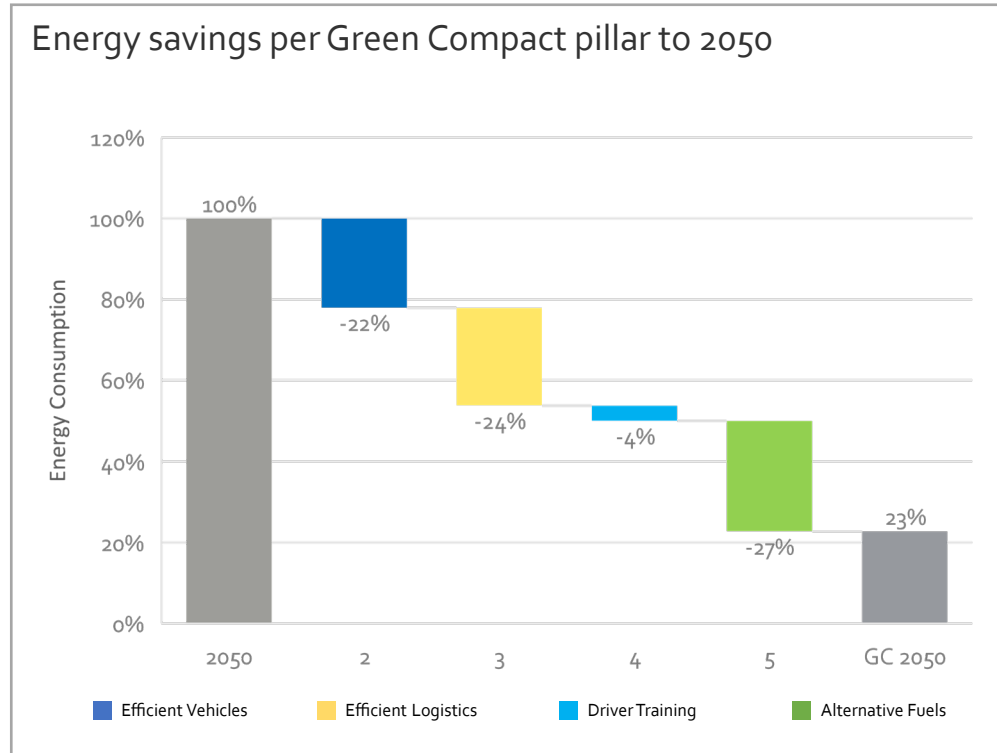
Demand from other industries for carbon-neutral fuels will also be high.

A mix of different zero- and low-carbon fuel solutions needs to be available for commercial operators to choose the right technology for the right transport use, including biofuels, biogas and e-fuels as well as electricity and hydrogen.

**49%** of the CO<sub>2</sub> emissions reductions to make the sector carbon neutral by 2050 can be achieved with feasible and economic alternative fuels implementation

## 5. The way forward: A duplex strategy

### Scenario to 2050: Efficiency wins and alternative fuels



## 5. The way forward: A duplex strategy

### A multitude of solutions working together on both levels

Many actions are needed, in different mixes for different countries, to deliver the duplex strategy to reach carbon neutrality by 2050.

Here are some examples framed by the five pillars of the Green Compact.

**1. Alternative fuels** – economic and operationally feasible battery-electric, biofuel, biogas, eFuel, fuel-cell, hydrogen combustion, and clean hydrogen solutions.

**2. Efficient logistics** – retiming, platooning, digitalisation, eco-trucks, route optimisation, advanced routing, connected vehicles, trade facilitation and border processes.

**3 Efficient vehicles** – tyres, lightweighting, waste heat recovery, solid state membrane, fairings, and lubrication.

**4. Efficient drivers** – eco-driving, driver monitoring, skills monitoring, education, and certification schemes.

**5. Collective mobility** – mobility-as-a-service, public transit incentives, integrated ticketing and timetabling, and private vehicle restriction schemes.

Encouraging more people to shift from private to collective mobility (bus and coach services) will further boost the results of the duplex strategy – both in terms of efficiency wins and scaling up alternative fuel solutions. This could mean that carbon neutrality is achieved before 2050 and at a lower public and private investment cost.

## 6. Policy principles

Delivering the many solutions needed to decarbonise commercial road transport in a pragmatic and cost effective way – while keeping transport networks moving – requires collaboration from regulators, suppliers and users.

Governments and authorities need to recognise, enshrine and act on the following global principles:

a. Commercial road transport is an **essential service**

b. The industry is committed to meet decarbonisation targets given the right **regulatory framework** and enabling environment

c. Transport services need to be decarbonised while **minimising disruption** and not harming the people and their livelihoods who depend on those services

d. Decarbonisation solutions need to be **feasible, economic and operationally realistic** for transport operators to implement

e. Many solutions are needed to decarbonise the diverse commercial road transport sector; regulators need to encourage a range of solutions and remain **neutral on technology** options

f. Every country has a different transport, energy and development landscape; governments and international bodies need to be **flexible on the right mix of solutions** for each country

## 6. Policy principles

g. Governments should establish transport decarbonisation policies that **maximise the amount** of CO<sub>2</sub> emissions that can be cut and **minimise the cost** to public and private sectors

h. Governments and regulators need to measure and monitor emissions correctly to accurately target CO<sub>2</sub>, using a **well-to-wheel approach** instead of tank-to-wheel (for all transport modes); this also avoids distorted policy outcomes and misdirected or wasted public and private investment

i. Decarbonisation policies will be more successful when they target, **in parallel**, both energy efficiency and new carbon-neutral sources of alternative energy

j. Governments and regulators need to **work in cooperation** with transport operators, as well as their suppliers and clients, not against them

k. Global coordination and **harmonisation on standards** is necessary to scale up solutions effectively and minimise investment costs

## 7. Next steps

IRU is engaging its members, governments, international organisations, NGOs and other stakeholders to continue identifying, testing and scaling up solutions, including:

- Stakeholder roundtables
- IRU modelling assessments
- Monitoring tool design
- Regional and national assessments
- Second level data collection



# Intelligence Briefing ■

## About IRU

IRU, the world road transport organisation, has 75 years of on-the-ground experience with a network of 175 members from around the world. We represent the entire industry – bus, coach, truck and taxi, and strive for the sustainable mobility of people and goods across the planet.

As the voice of more than 3.5 million companies operating mobility and logistics services in over 100 countries, IRU fosters impactful solutions to help the world move better. We bring a unique perspective, bridging the public and private sectors to support trade, economic growth, jobs, safety, the environment and communities.

IRU provides concrete services to transport and logistics companies, ranging from representation at the European and global level, trade and transit tools, driver skills assessments and eco-driving training, comprehensive research and insights with thematic workshops and roundtables on decarbonisation, driver shortages and digitalisation.



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