

# The European Commission's science and knowledge service

Joint Research Centre

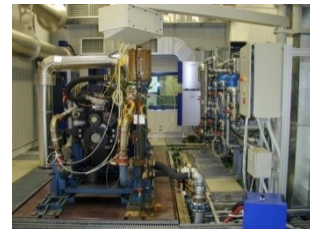
## Insights on research and policy for road transport decarbonisation

**Georgios Fontaras**

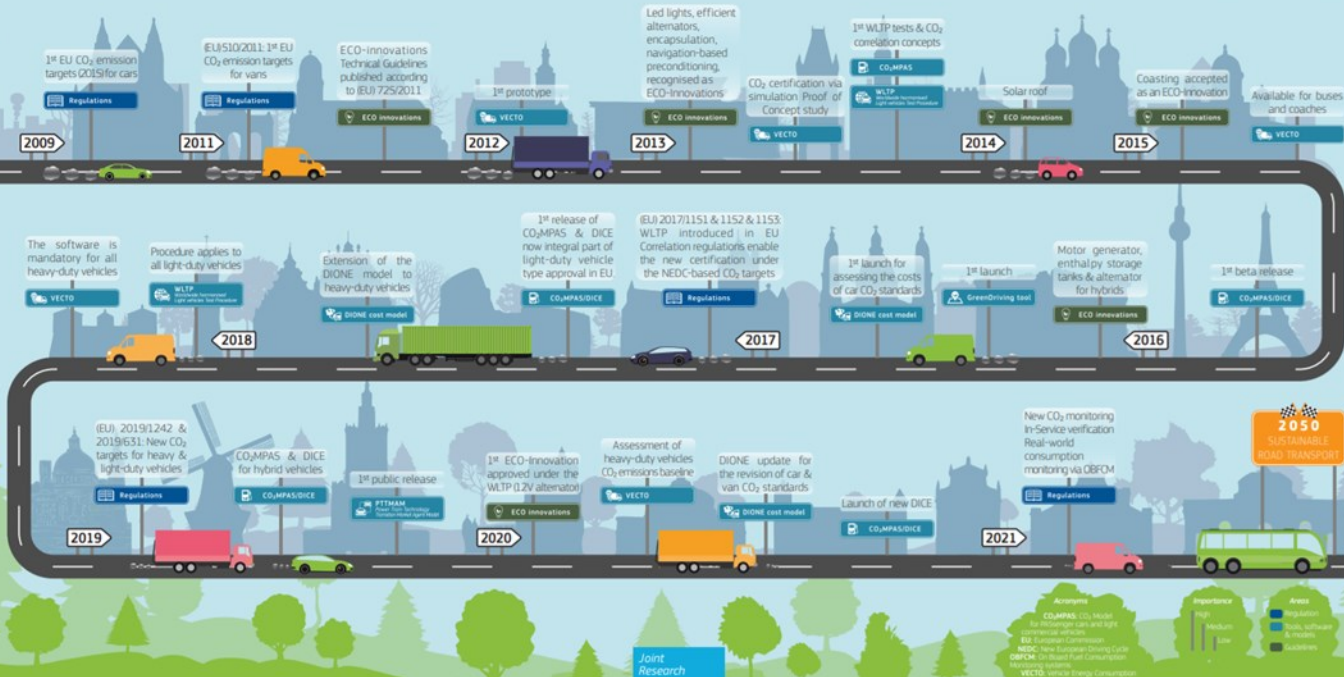


# JRC Research

- European Commission's Research for Policy DG
- Mission: Contribute to the anticipation, design and implementation of EU policy
- STU: To support the development and diffusion of sustainable, efficient, and fair road vehicles and transport



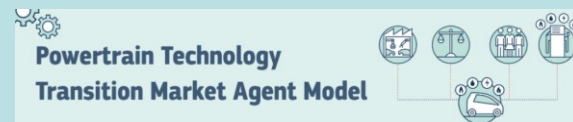
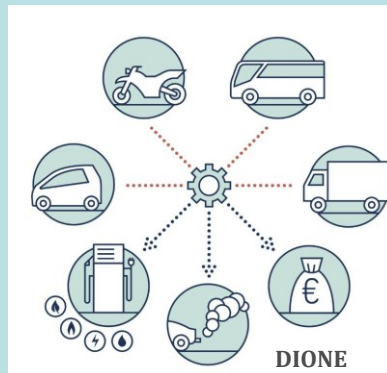
# Our contribution towards road vehicle decarbonisation policy



→ For over a decade we have actively contributed to all major policy initiative of the Commission for road vehicle decarbonisation

# Our tools used in CO<sub>2</sub> policy

Making use of multiple tools and extensive JRC know-how



Emissions  
Projections



Costs

Technology  
diffusion



Progress  
monitoring

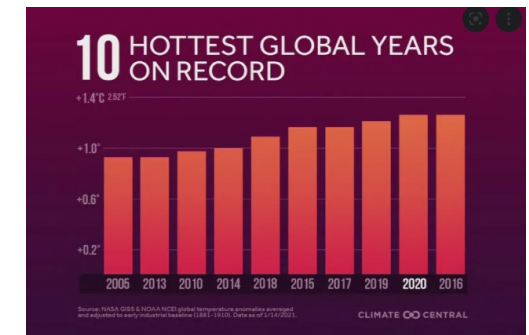
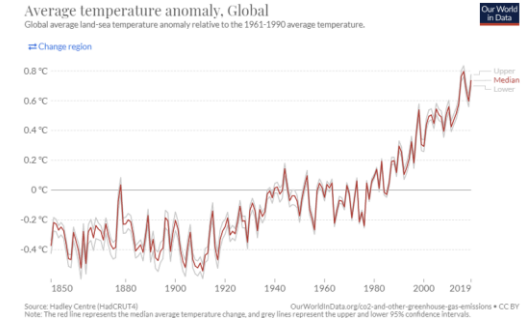
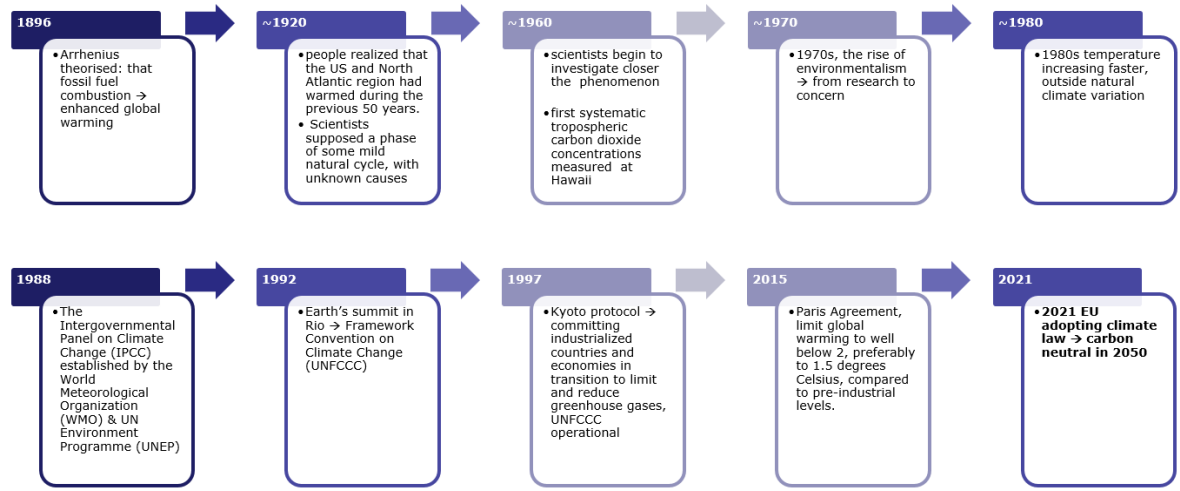
# Outline

- Motivation
- The challenge
- A more ambitious step forward
- The elephant in the room

# Outline

- Motivation

# Global warming – a long history

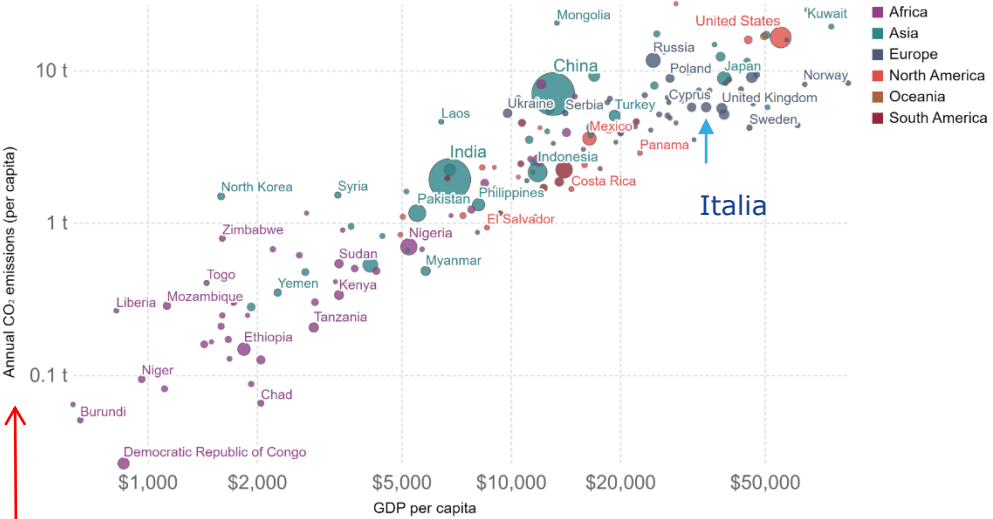


• ....Still some people remain unconvinced that action is needed

# Carbon emissions and prosperity

## CO2 emissions per capita vs GDP per capita, 2018

This measures CO2 emissions from fossil fuels and cement production only – land use change is not included. Gross domestic product (GDP) per capita is measured in international-\$ in 2011 prices to adjust for price differences between countries and adjust for inflation.



Energy consumption is a measure of our prosperity and quality of life

Ancient times:  
sun → crops → human & animal labor

Post industrial societies:  
carbon → fuel → machine work

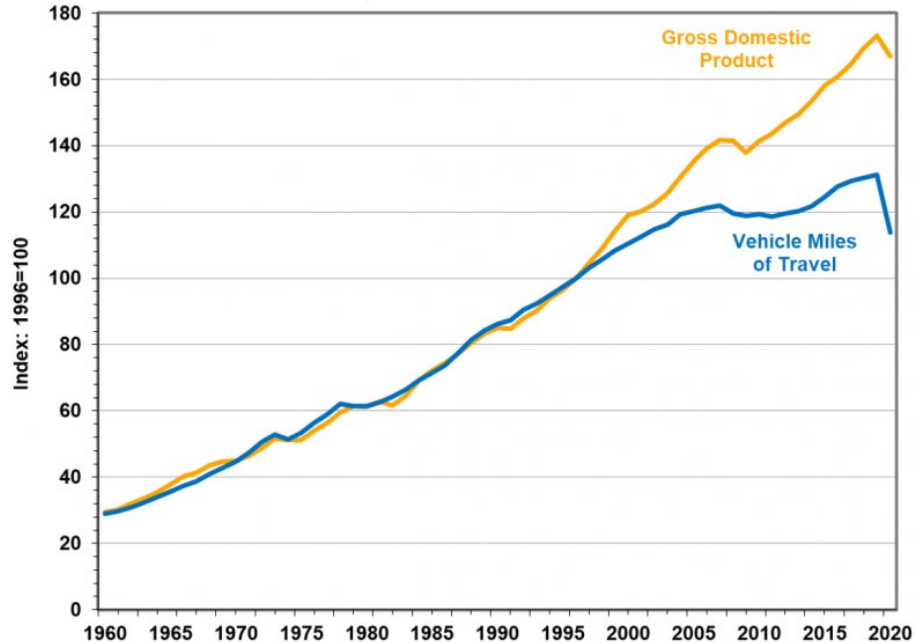
Source: Our World in Data based on the Global Carbon Project, Maddison Project Database 2020 (Bolt and van Zanden (2020))  
OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

**Log – Log scale!**

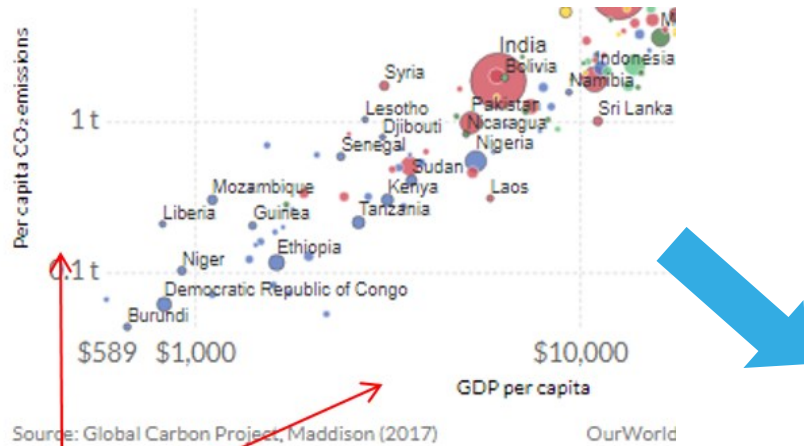


# GDP vs vehicle kilometers driven

...prosperity & transport activity go hand in hand

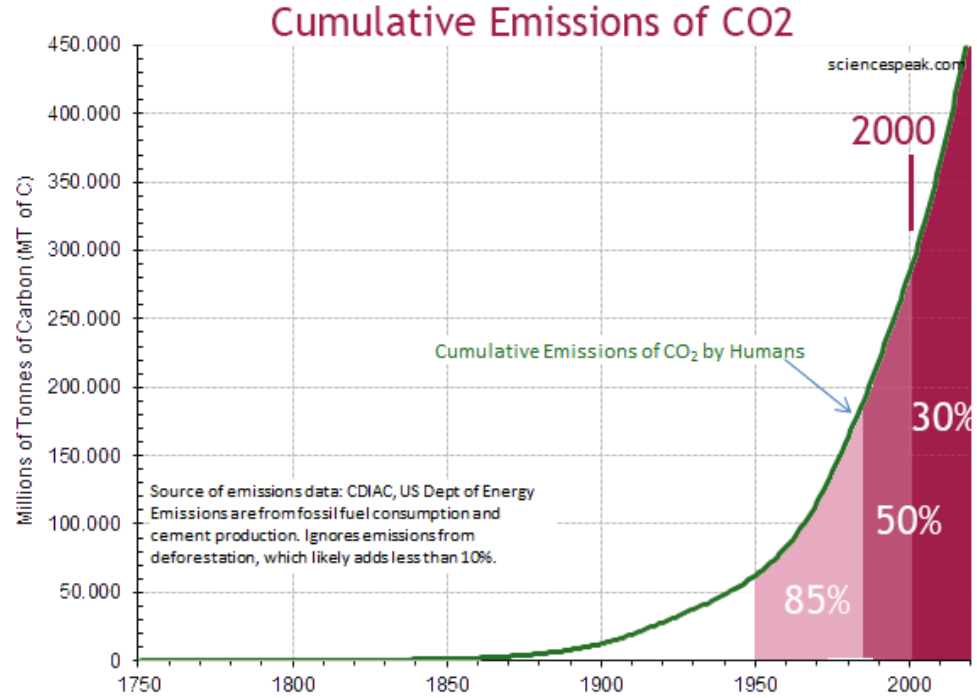


# But are we running out of time?



**Log - Log scale!**

6



# Public sentiment

*93% Europeans believe that climate change is a serious problem. These results are stable since 2019.*

*49% of Europeans consider it the 2<sup>nd</sup> most important problem the world is facing behind poverty hunger and lack of water*

*Europeans expect even stronger action from both their national government and the European Union to fight climate change*

*(EU barometer 2021)*

# The European Climate Law 2021/1119/EU

## ■ Considerations

- *The existential threat posed by climate change requires enhanced ambition and increased climate action by the Union and the Member States.*
- *Union greenhouse gas emissions were **reduced by 24 %** between 1990 and 2019, while the **economy grew by 60 %** over the same period*
- ***All sectors of the economy** –including energy, industry, transport, [...]– should play a role in contributing to the achievement of climate neutrality*

# The European Climate Law - Highlights

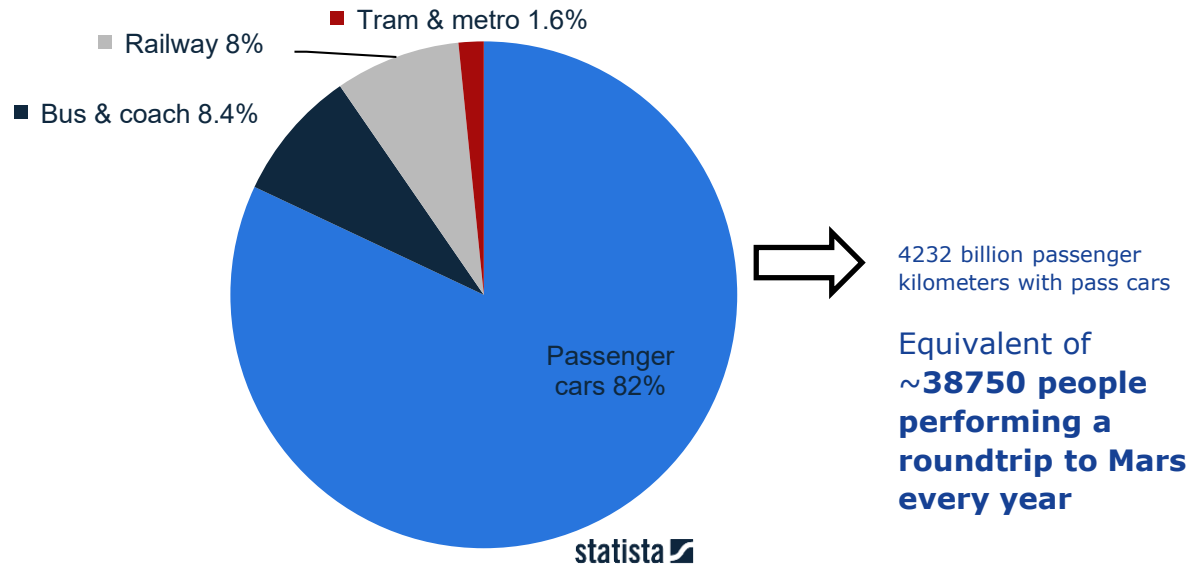
- **Union-wide climate-neutrality objective 2050**
- New **2030** target of at **least 55% net** greenhouse gas emissions reduction

# Outline

- The challenge

# Distribution of passenger-kilometers traveled by land in the European Union (EU-28) in 2019, by mode of transport

Europe (EU-28): modal split of passenger transport on land 2019

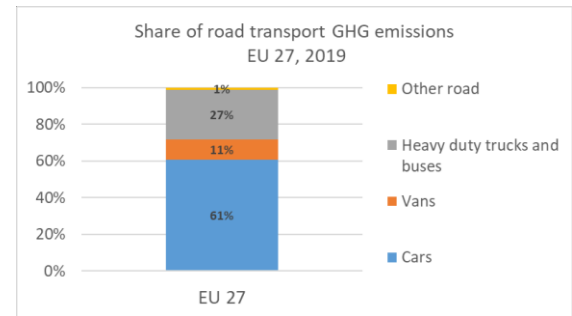
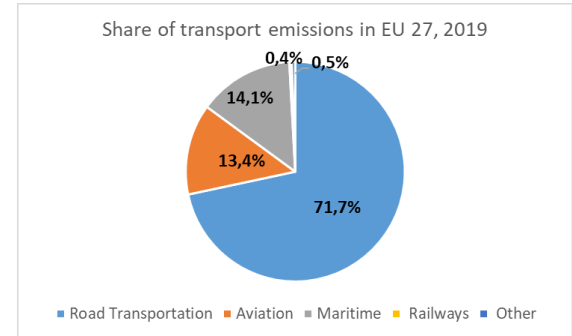
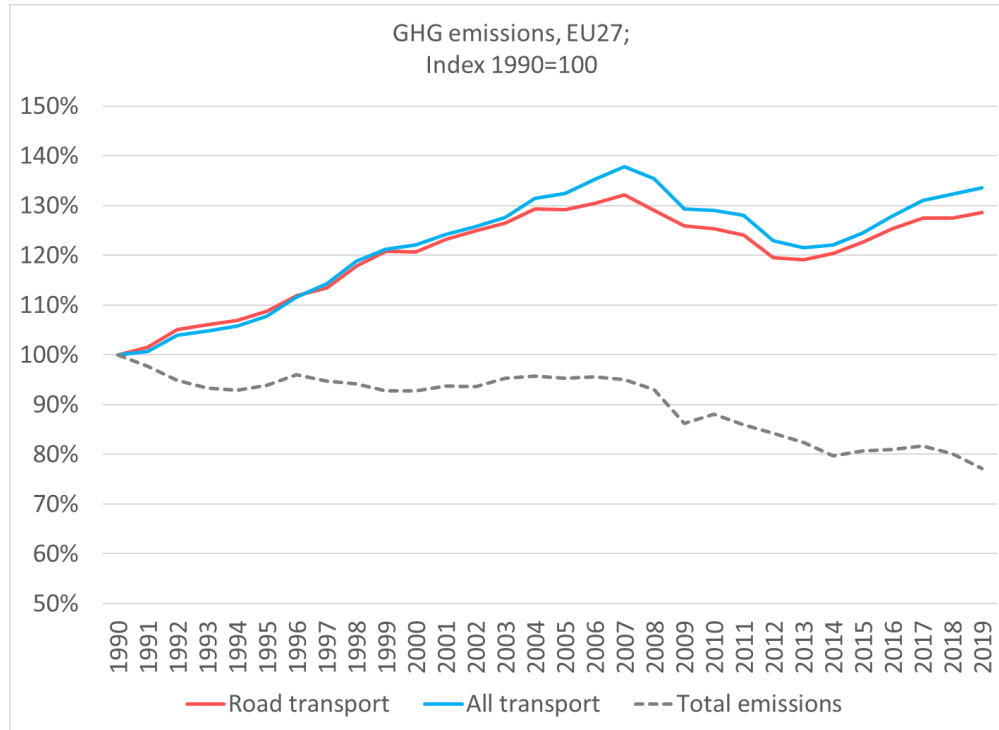


Note(s): EU; 2019

Further information regarding this statistic can be found on [page 56](#).

Source(s): European Commission; ITF; Eurostat; [ID 449486](#)

# Trends in EU greenhouse gas emissions & transport



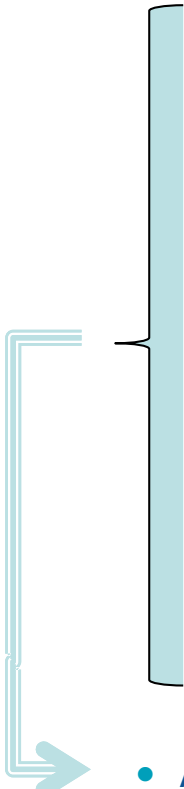


# The European Climate Law 2021/1119/EU

## ■ Considerations

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- *Union greenhouse gas emissions were **reduced by 24 %** between 1990 and 2019, while the **economy grew by 60 %** over the same period*
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# Regulatory timeline Light Duty Vehicles



1974: First emissions regulation / test method established  
1980: Inclusion of CO<sub>2</sub> emissions in testing  
1991: First discussions on CO<sub>2</sub> targets  
1995: the EC proposed '120g/km target by 2005'  
1998: A Voluntary Agreement of '140 g/km by 2008'  
2009: '120(130)g/km by 2015' & '95 g/km by 2020'  
2013: EP accepts 95g/km (2021), and proposes 68–78g/km (2025)  
2014: 95g/km (2021) target set by the EU law  
2016: Introduction of RDE regulation  
2017: WLTP & correlation regulations, HDV CO<sub>2</sub> certification  
2018: HDV CO<sub>2</sub> emissions monitoring  
2019: New CO<sub>2</sub> standards -15 & -37.5% for LDVs, -15% & 30% HDVs  
2021: CO<sub>2</sub> standards update....

- All targets are based on CO<sub>2</sub> emissions measured during vehicle type-approval (type I test)

# Current CO<sub>2</sub> standards (Regulation(EU) 2019/631)

- **Targets for EU fleet-wide average tailpipe CO<sub>2</sub> emissions** of all new vehicles:
  - until 2024: WLTP-based equivalent of 95g CO<sub>2</sub>/km (NEDC); vans 147g CO<sub>2</sub>/km (NEDC)
  - 2025-2029: cars and vans -15% reduction vs 2021 (WLTP)
  - from 2030: cars -37.5% reduction vs 2021; vans -31% reduction vs 2021 (WLTP)
- **Specific targets** for individual manufacturers & compliance assessment
- **Incentive scheme for zero- and low-emission vehicles (ZLEV < 50 g CO<sub>2</sub>/km)**
- **Governance & Monitoring** provisions including penalties, monitoring of real-world emissions, in-service verification

**CH:** 95g/km from 2020; will be 118 gCO<sub>2</sub>/km in 2021.

# Targets (CO<sub>2</sub>) ≠ Limits (eg Euro 6)



A vehicle can be sold in Europe regardless of its CO<sub>2</sub> emissions

The targets concern the entire fleet of a manufacturer  
Exceeding them is associated with high fines to the manufacturer



A vehicle can be sold in Europe ONLY if the emissions NO<sub>x</sub>, CO, PM, PN, HC are lower than the Euro 6 limits



Both CO<sub>2</sub> and pollutants are measured over the official test during the type approval process (**NEDC before 2017, WLTP today**)

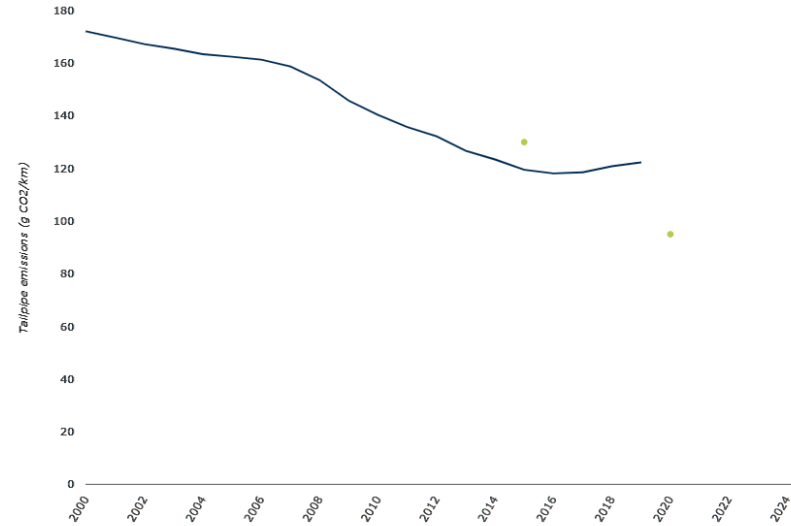
# CO<sub>2</sub> emissions from cars and vans

CO<sub>2</sub> standards are delivering: key driver for decarbonisation of fleet

- 2020 surge in the penetration of Zero and Low Emission Vehicles: from 3% in 2019 to 11% of new sales in 2020 as result of new 2020 stricter targets

Industry: ambitious announcements from manufacturers towards zero-emission vehicles in their portfolios

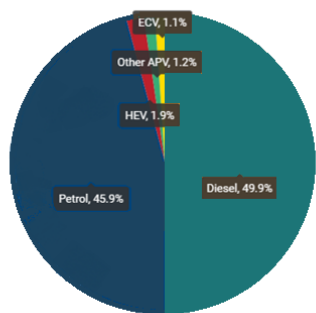
Global market for zero-emission vehicles growing rapidly – EU, China, US



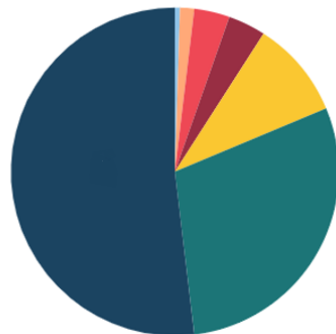
# Rapid introduction of electrified vehicles

Are we experiencing a real shift?

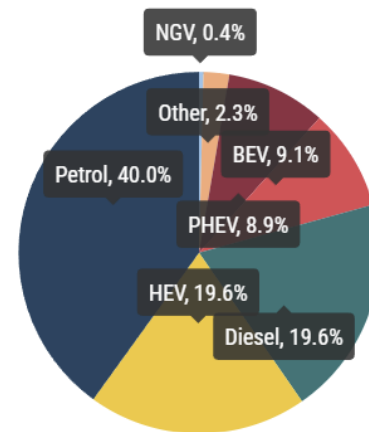
■ Petrol ■ Diesel ■ Battery electric (BEV) ■ Plug-in hybrid (PHEV) ■ Hybrid electric (HEV)  
■ Natural gas (NGV) ■ Other



2016



2020



2021

## But reality and policy did not tell exactly the same story until recently



Everyday  
practice...

Authors2017	Year	Country	Additional CO2 in real world operation
Weiss et al	2011	EU	21%
Ntziachristos et al.	2011	EU	25%
Fontaras & Dilara	2012	EU wide	22.5%
Lingterink et al	2013	Netherlands	30%
Mock et al	2014	EU	38%
Lingterink et al	2014	Netherlands	44%
Tietge et al.	2016	EU	40%
Zacharof et al.	2016	EU	36%
Fontaras et al.	2017	EU	37%

And scientific research...

# Outline

- A more ambitious step forward



# 2021 a busy summer .....

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June 24, 2021  
1:23 PM CEST  
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Europe

## Climate 'law of laws' gets European Parliament's green light

Re:  
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## Fit for 55: EU rolls out largest ever legislative package in pursuit of climate goals

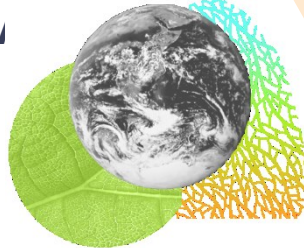
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# 'Fit for 55' package



**TAXATION & TRADE**

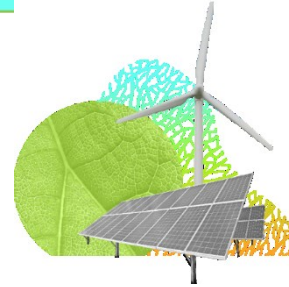
**CLIMA**



**Work in progress: Revision of CO<sub>2</sub> standards for heavy duty vehicles**



**TRANSPORT**



**ENERGY**

- Pricing*
- Rules*
- Targets*
- Support*

# Main elements of the proposal - targets

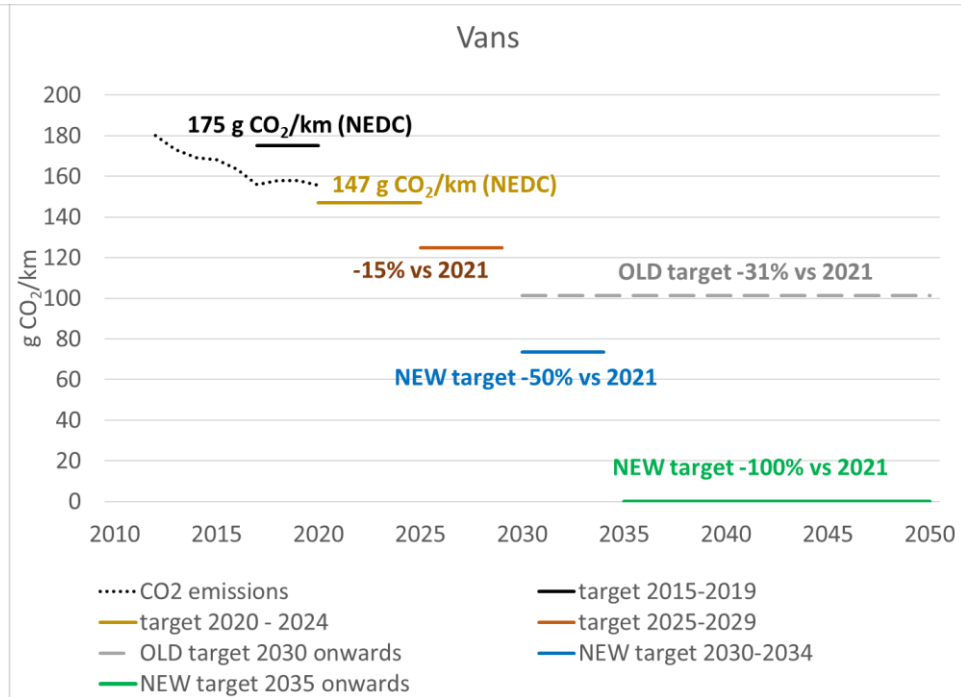
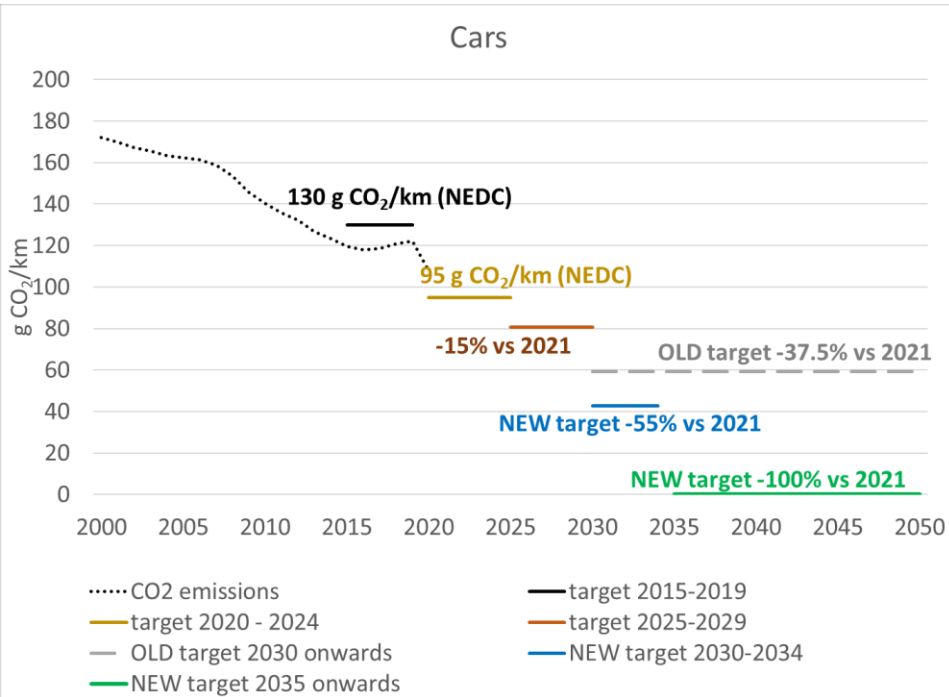
Proposed EU fleet-wide CO<sub>2</sub> emission reduction targets for new passenger cars and vans as compared to the 2021 target:

- until 2029: no change
- from 2030: -55% for cars and -50% for vans
- **from 2035: -100% for cars and -100% for vans (only LDVs covered by the proposal!).**

Specific targets for individual manufacturers for compliance assessment

Removal of ZEVs after 2030

# Trends and targets



# Road transport in ETS - proposal

Fit for 55: extends ETS to maritime, road transport, & buildings, more ambitious for aviation

Road Transport ETS proposed to start applying by 2026:

- **Separate system focused on upstream fuel suppliers; responsibility of fuel producers to comply with the system**
- **Will increase incentives to supply cleaner fuels for existing vehicles & push providers to decarbonize their fuels**
- **Stimulate the evolution of the available fuels on the market for existing and future fleets**
- **Emissions will be capped, with the cap reduced over time so that total emissions fall**
- **Earnings to be used in different EU funding instruments like the EU social fund, Climate innovation fund, and modernization fund**

# AFI within Fit for 55

Proposal for a regulation that covers Alternative Fuels Infrastructure in the EU repealing existing directive

Sets out mandatory national targets for the deployment of sufficient alternative fuels infrastructure in the Union, for **road vehicles**, **vessels** and **aircraft**

Road vehicles:

- **Targets for charging infrastructure linked to ZEV sales**
- **LDVs: 1kW per EV, 0.66kW per PHEV through public infrastructure, min. one station every 60km; capacity provisions for HDVs**
- **H<sub>2</sub> refuelling, one station every 150 km along the TEN-T core network and in every urban node serving both LDVs and HDVs.**

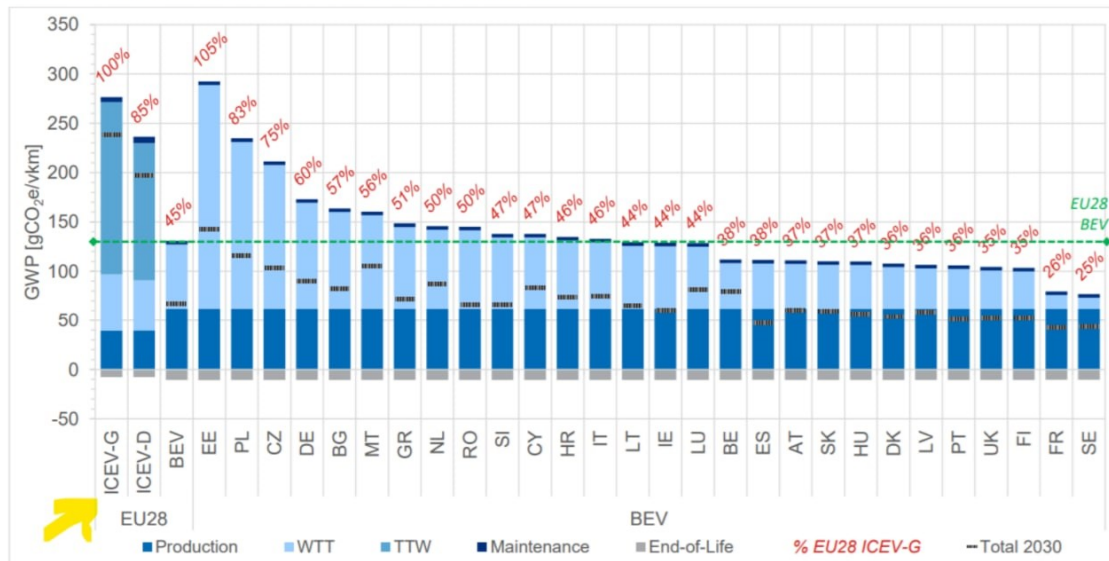
# ....How about LCA

Commission first study concluding that EVs are in the worst case equivalent to conventional vehicles

Similar findings with JRC-EUCAR-CONCAWE WTW study

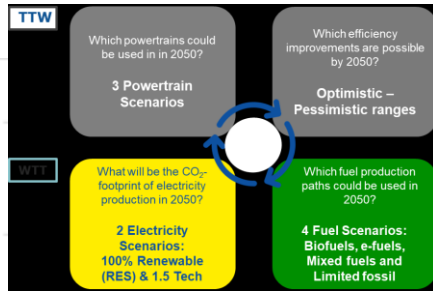
Topic is vast, on-going collaborations

Figure ES5: Comparison of Lower Medium Car lifecycle GWP impacts for conventional gasoline/diesel ICEVs and BEVs for different EU countries, Baseline scenario. Breakdown shown for new 2020 vehicles, and the total only for new 2030 vehicles.

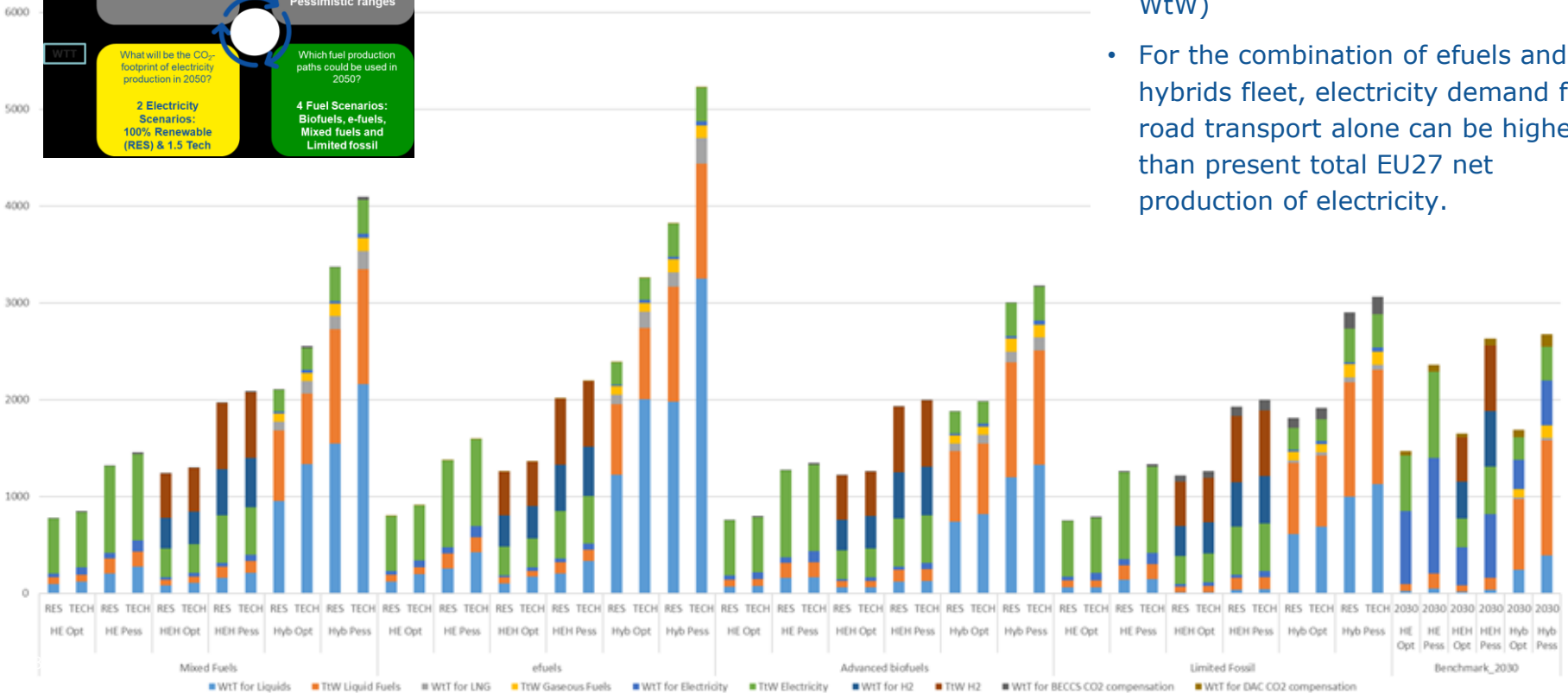


Notes: Results shown for the lower medium car in the baseline scenario. Production = production of raw materials, manufacturing of components and vehicle assembly; WTT = fuel/electricity production cycle; TTW = impacts due to emissions from the vehicle during operational use; Maintenance = impacts from replacement parts and consumables; End-of-Life = impacts/credits from collection, recycling, energy recovery and disposal of vehicles and batteries. Additional information on key input assumptions and derived intermediate data include the following: a lifetime activity of 225,000 km over 15 years. 2020 BEV battery of 58 kWh, with 300km WLTP range (and with 64 kWh and 460 km WLTP electric range for 2030); an average lifetime EU28 fuel/electricity mix (age-dependant mileage weighted). No battery replacement is needed for BEVs.

# ERTRAC-JRC study



WtW Energy [TWh], carbon neutral



- Fleet electrification is the strongest driver in transport energy consumption reduction (TtW and WtW)
- For the combination of efuels and hybrids fleet, electricity demand for road transport alone can be higher than present total EU27 net production of electricity.

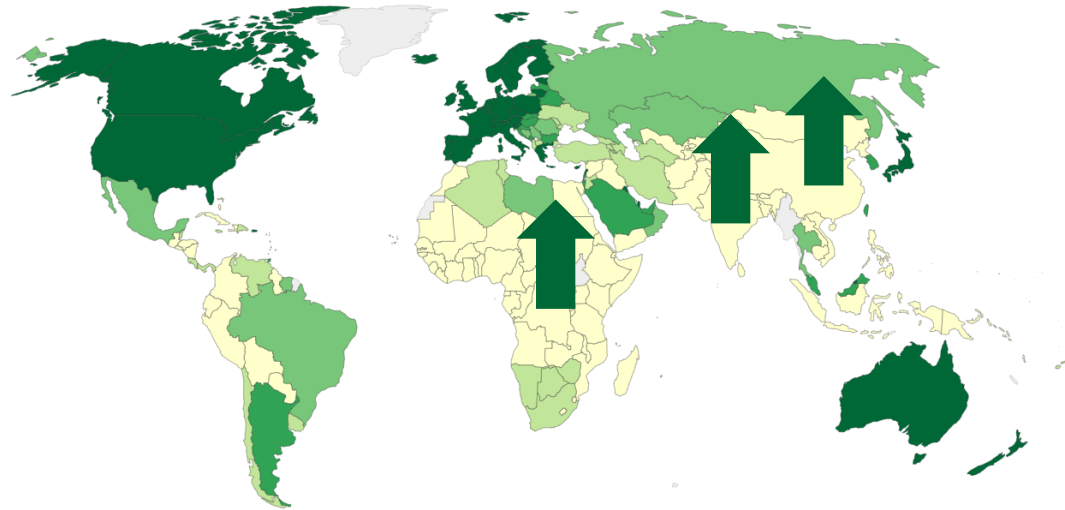


# Outline

- The elephant in the room

# How many vehicles are too many vehicles?

## Vehicles per 1000 people (2014)



- Worldwide: > 1 billion
- What will happen as global GDP increases?
- Plenty of margin for even more vehicles in the developing world.



## ...We should not judge global mobility based on EU reality...



Mumbai urban area 20 million inhabitants



IIT Mumbai 29/5/19

Most of the Earth's population just entered the era of intensely mechanized mobility

→ Can we come up with less carbon intensive, affordable solutions to support their growth?

# Challenges for mobility in a developing market:

- A large share of vehicles in developing countries are 'second hand'
  - **EVs increase in developed countries → risk of dumping of older conventional technology to developing world**
  - **Will retired of EVs/ZEVs be as functional as conventional vehicles?**
  - **Will degraded batteries be cost effective to use for second life applications, how much "green" will be the later disposal of these vehicles and batteries.**



# Consensus that change brings opportunity

*About ¾ of Europeans think:*

- ***that promoting EU expertise in clean technologies can help create new jobs,***
- ***that taking action on climate change will lead to innovation that will make EU companies more competitive,***
- ***that the costs of the damage due to climate change are much higher than the costs of the investments needed for a green transition***

*(EU barometer 2021)*

*Can we find the opportunities in change?*

# The billion € (or CHF) research questions:

- How can we decouple transport activity from carbon emissions?
  - How can we provide affordable and accessible transport for the rest of the world?
  - Can we really achieve sustainable mobility, for all and “fuel” carbon neutral growth inside and outside Europe?
- Academia, Industry, Policy collaborations are paramount for shaping the future

**Thank you for your attention!**

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