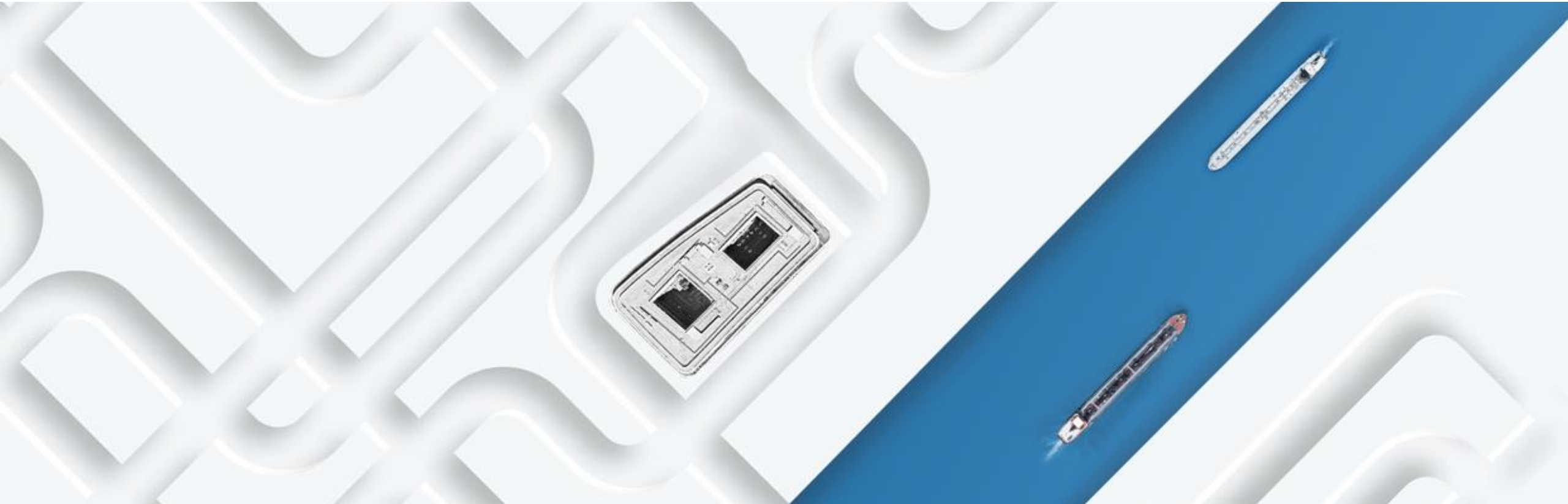


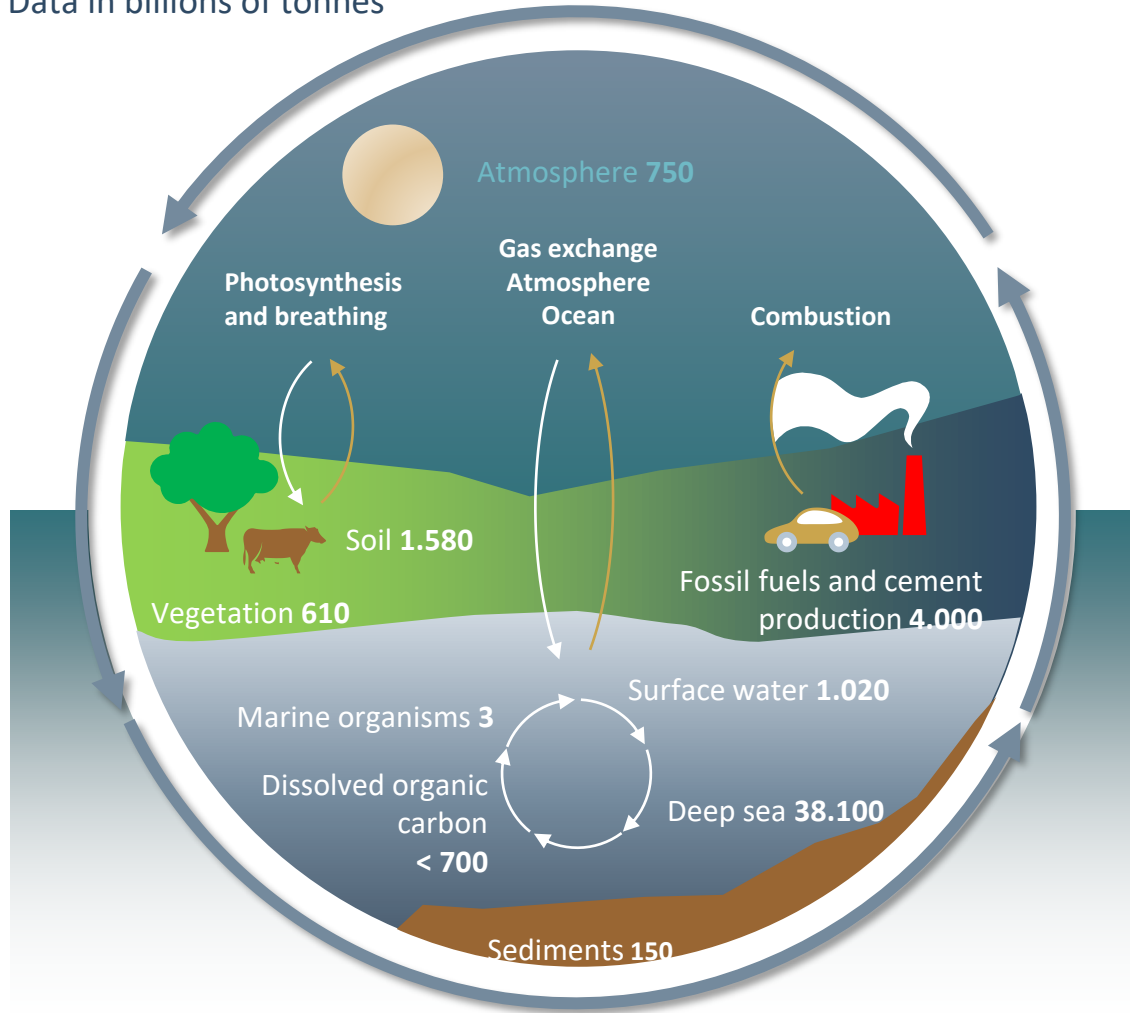
# Kompendium 5.0

## Section CO<sub>2</sub> emissions

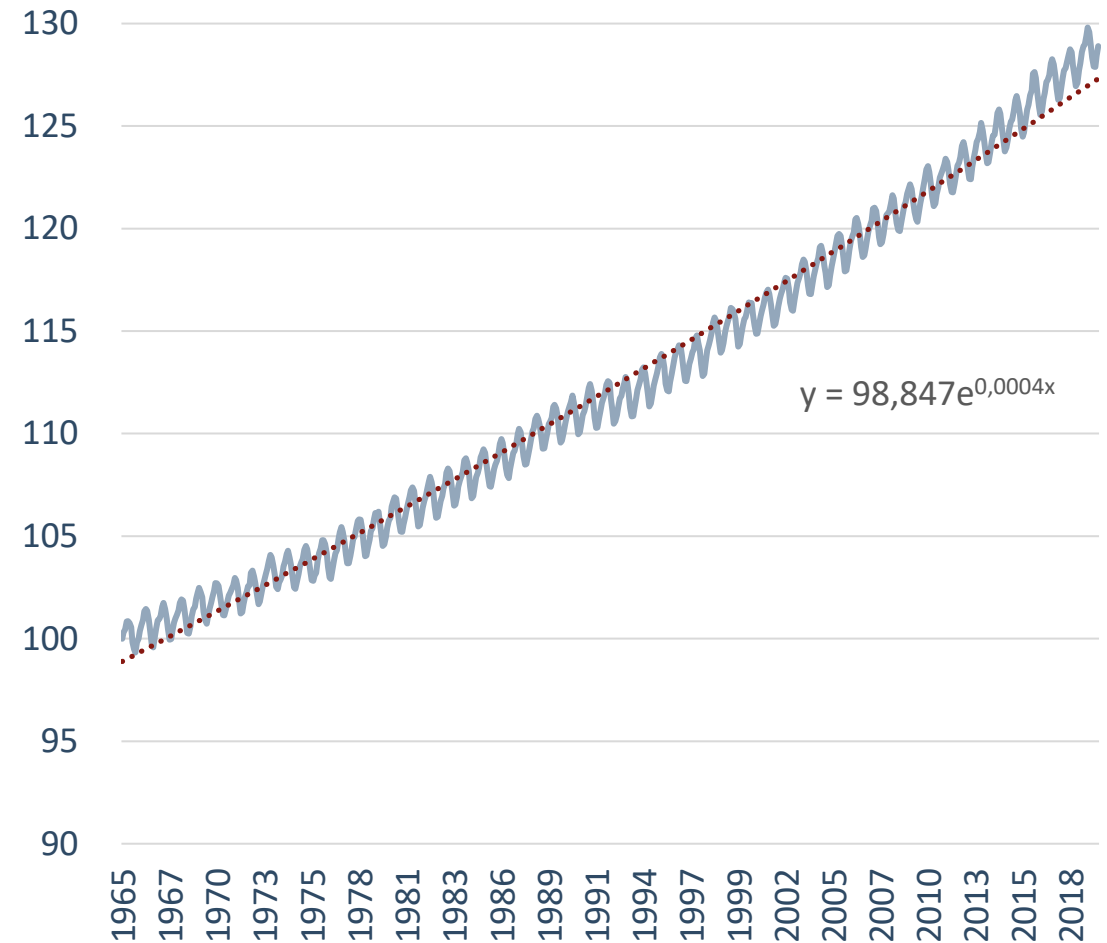


# Basics: The carbon cycle and CO<sub>2</sub>-concentrations

The ocean is the most important carbon store  
Data in billions of tonnes



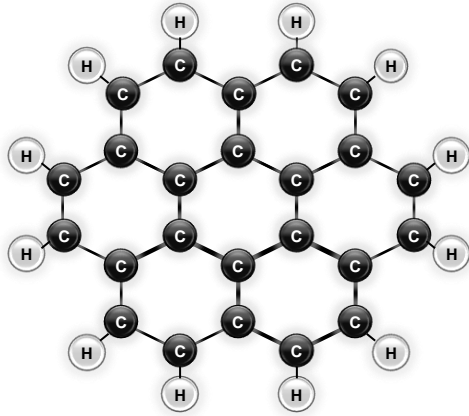
CO<sub>2</sub>-concentrations on Mauna Loa (Hawaii)  
January 1965 = 100



Source: Umweltbundesamt, 2020

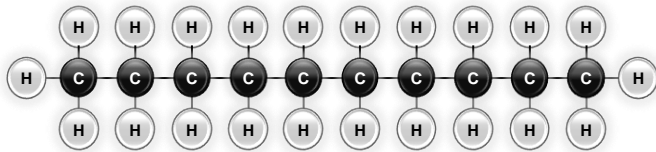
# Basics: Hydrogen to carbon ratio of fuels

Typical structure

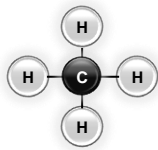


**Carbon**  
(Coronen)  
H:C = 0,1:1

**Mineral oil**  
(Decan)  
H:C = 2:1



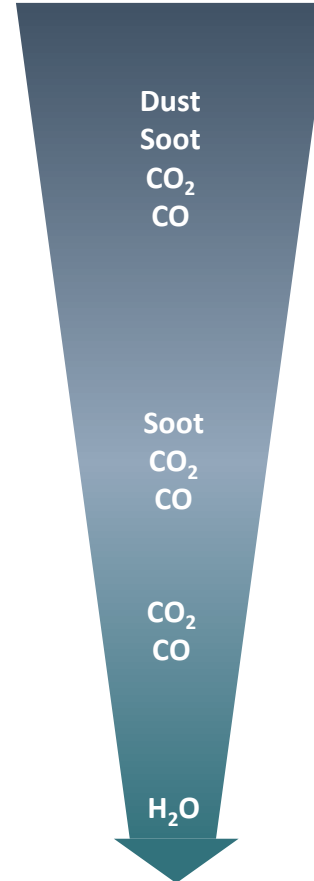
**Natural gas**  
(Methan)  
H:C = 4:1



**Hydrogen**  
(Molekular)  
H:C = 2:0



Main emissions



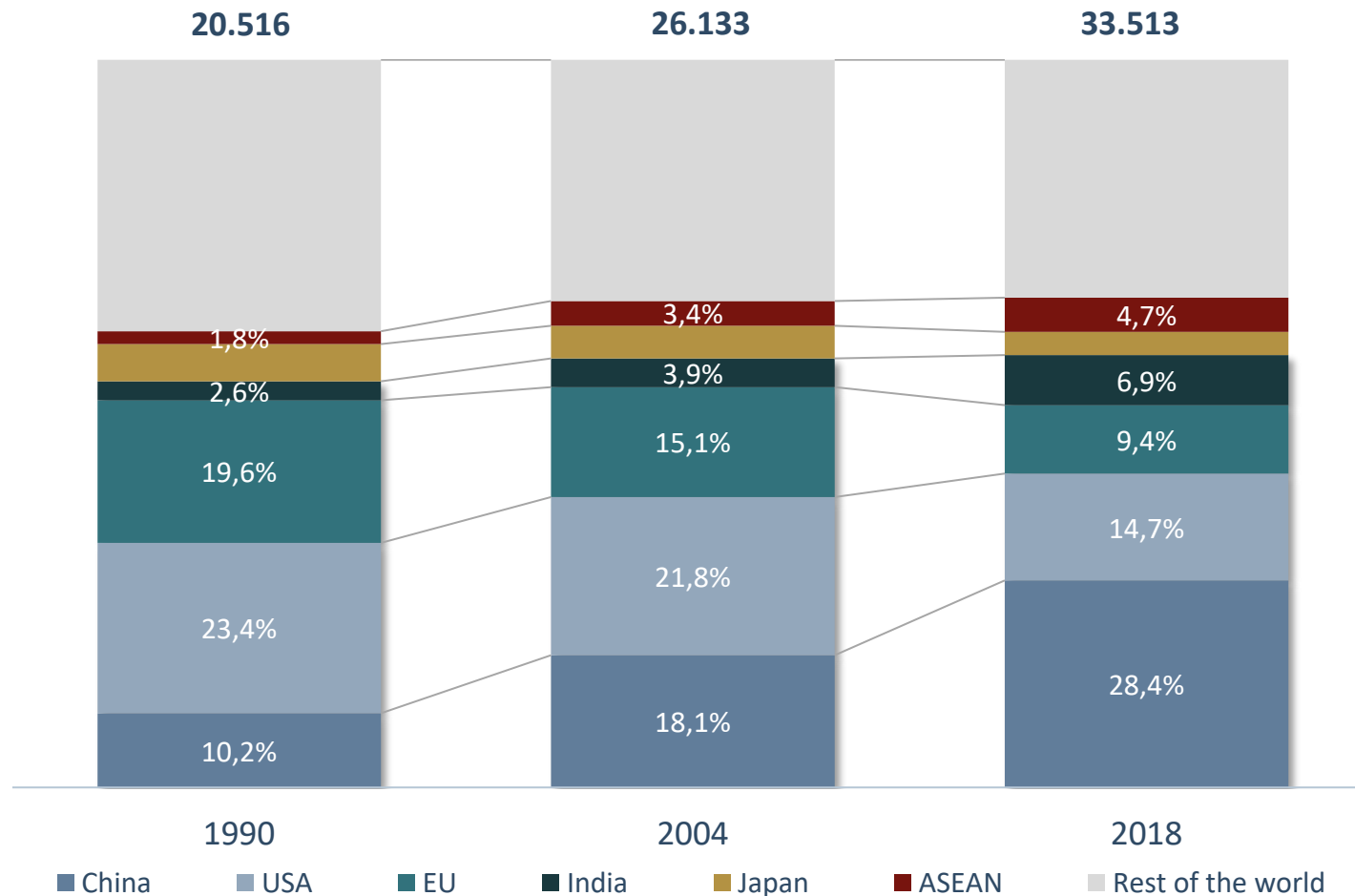
Direct emissions  
in g CO<sub>2</sub>/kWh

<b>Brown coal</b>	up to 1.150
<b>Black coal</b>	up to 950
<b>Diesel</b>	266,36
<b>Premium gasoline</b>	262,13
<b>Natural gas (H)</b>	200,00
<b>Hydrogen</b>	0,0

Source:

# Global CO<sub>2</sub>-Emissions: Europe's share continues to decline sharply

Emissions from fuel use in millions of tons

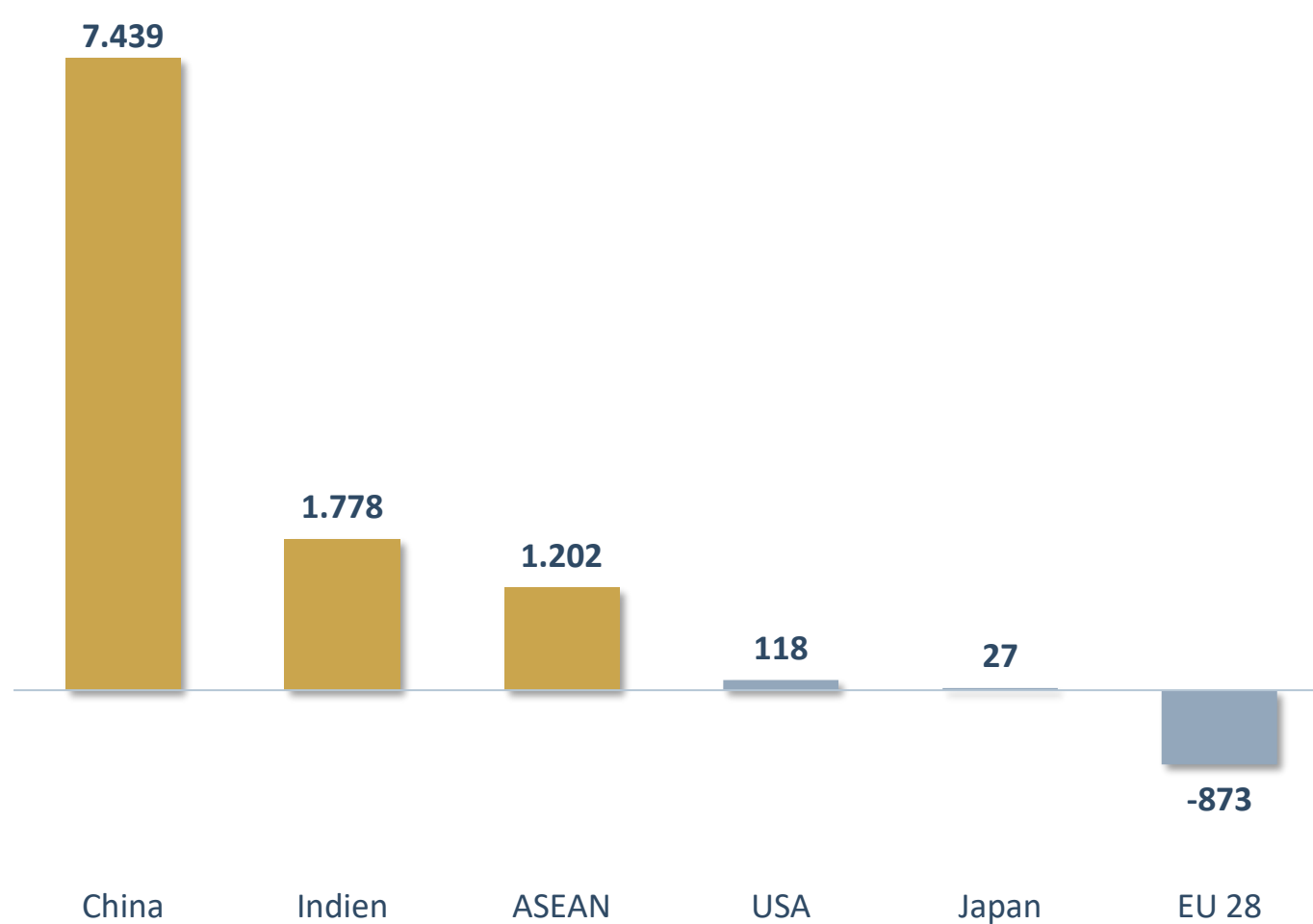


- ▶ Compared to the year 1990, absolute CO<sub>2</sub> emissions have so far only fallen in Europe. The decrease will be around 815 million tons by 2018.
- ▶ The USA are expected to fall below the 1990 level in 2019.
- ▶ The influence of European regulations on global CO<sub>2</sub> emissions continues to decline.

Source: IEA, CO<sub>2</sub> Emissions from Fuel Combustion – 2020

# Europe reduced - Asia grows strongly

Emissions from fuel use\* – Changes between 1990 and 2018 in millions of tons



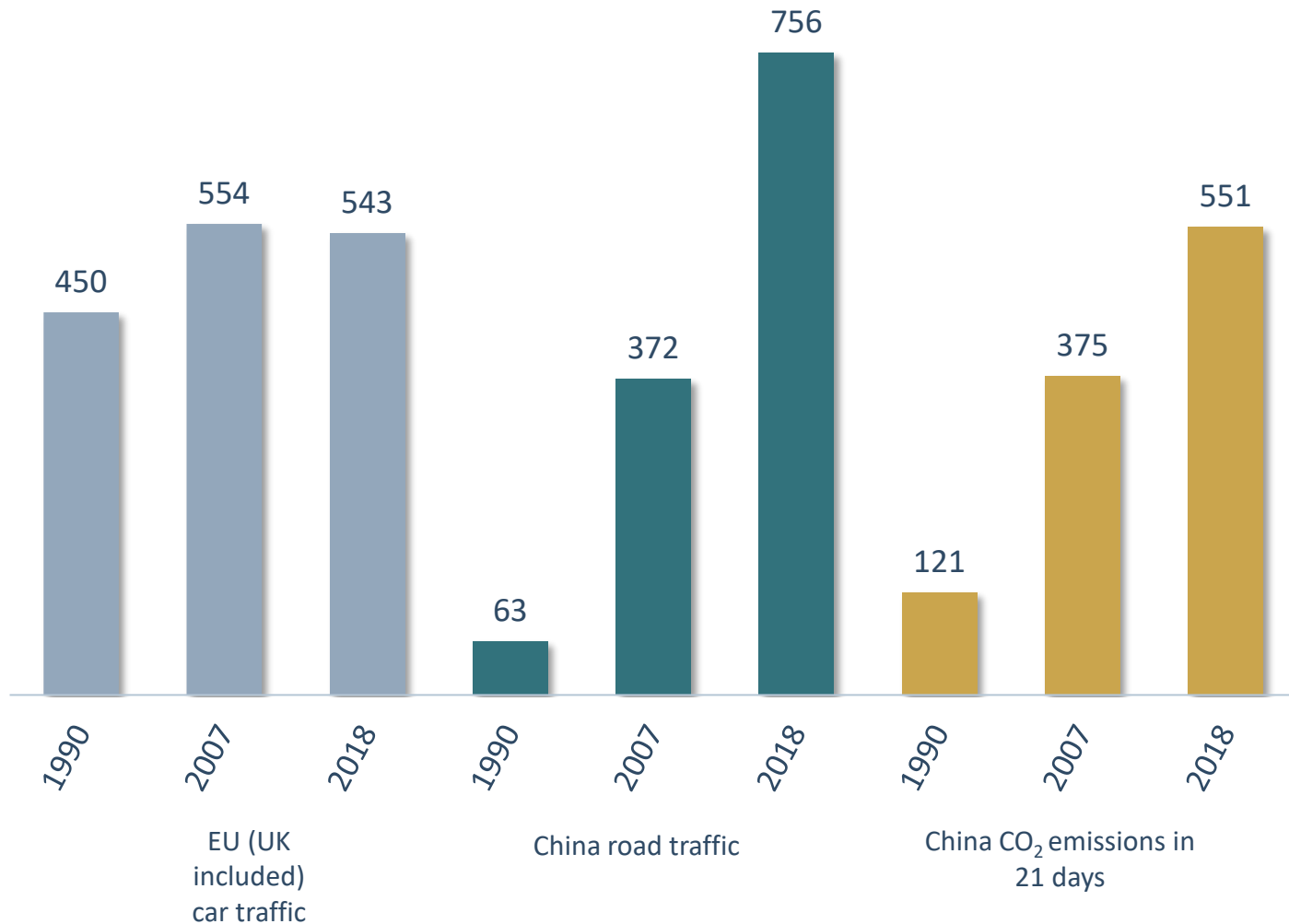
- ▶ While China grew by a good 351 percent in the years 1990–2018, the EU reduced it by 21.7 percent.
- ▶ China grew by a good 270 million tons in 2018 alone.
- ▶ In India, emissions have grown 335 percent since 1990 and increased by 140 million tons in 2018 alone.
- ▶ The EU (including UK) reduced its emissions by almost 60 million tons of CO<sub>2eq</sub> in 2018.

\* Corresponds to category 1A according to UNFCCC classification

Source: IEA, CO<sub>2</sub> Emissions from Fuel Combustion – 2020

# EU cars – Relevant, but not crucial

CO<sub>2</sub>-emissions in millions of tons

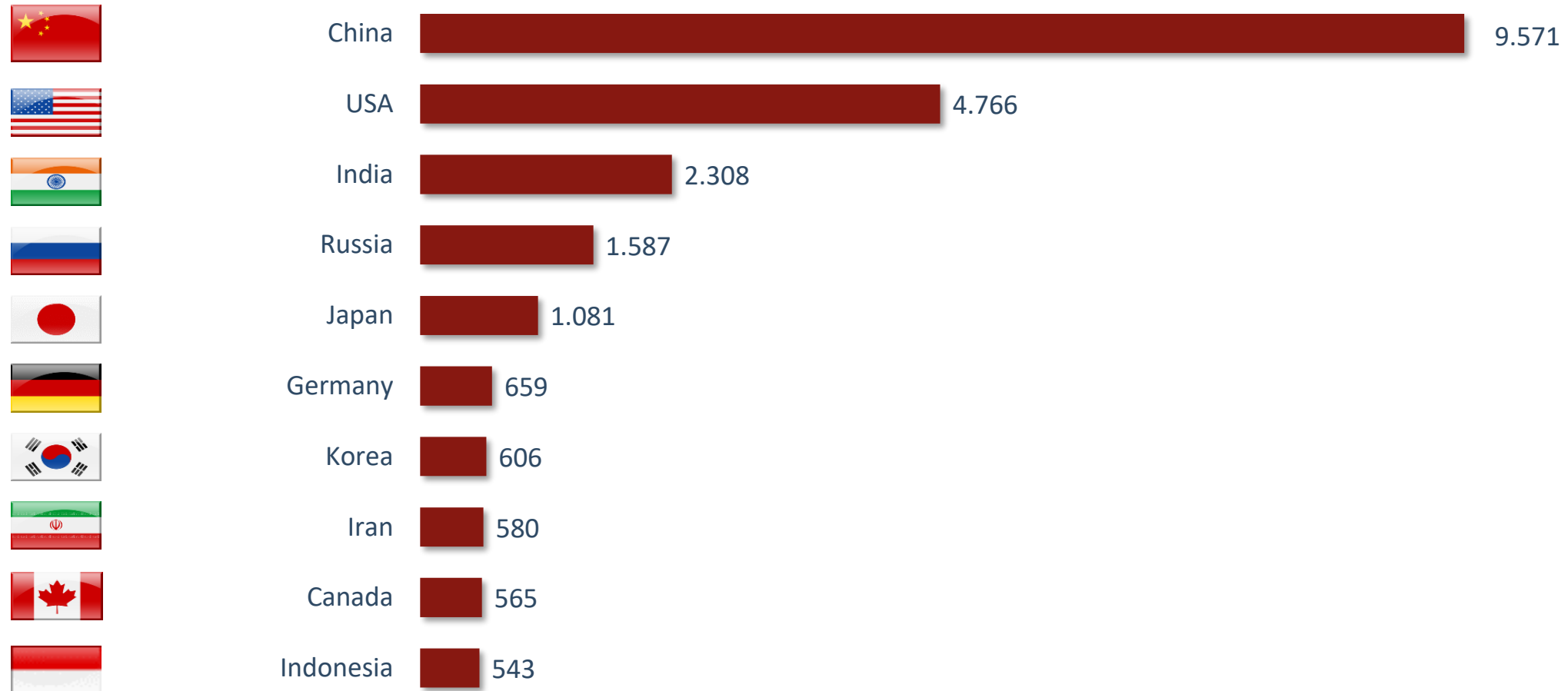


- ▶ Relevant: All European car traffic emitted a good 543 million tons of CO<sub>2</sub> in 2018. About 3 million t less than in the previous year.
- ▶ Crucial? In three weeks, China emits more CO<sub>2</sub> through the use of fossil fuels, as does car traffic in the EU over a whole year.
- ▶ Dynamics: From 2014 to 2015 the increase in China was 60 million tons. From 2017 to 2018 it was a good 30 million tons more.

Sources: EEA, 20 20 (v23); IEA, CO<sub>2</sub> Emissions from Fuel Combustion – April 2020

# 10 states – two thirds of the CO<sub>2</sub>-Emissions

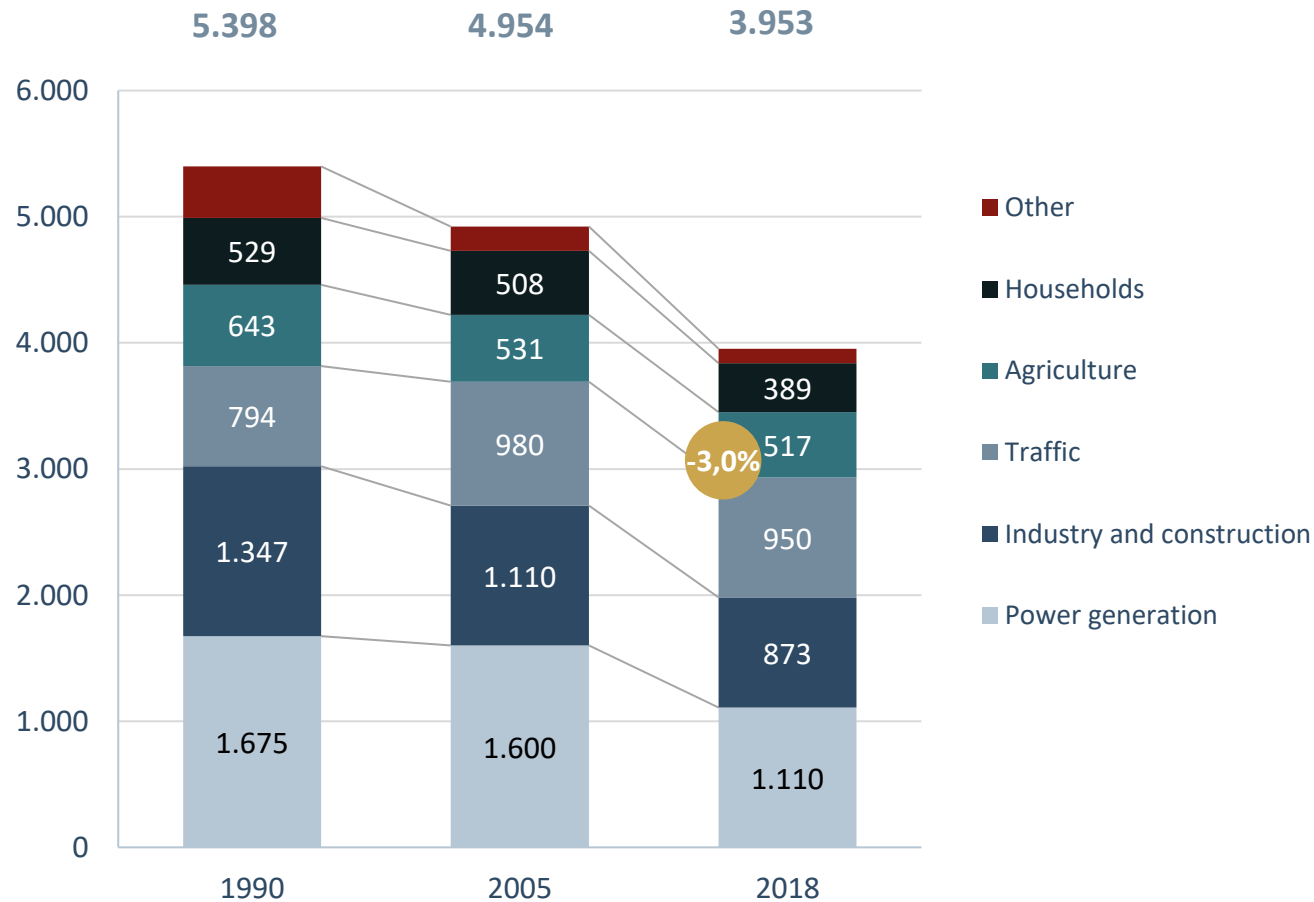
CO<sub>2</sub>-Emissions of the year 2018 in million tons



Source: IEA, CO<sub>2</sub> Emissions from Fuel Combustion – 2020

# Sector development

Greenhouse gas emissions in the EU28 (UK included) by sectors in million tons



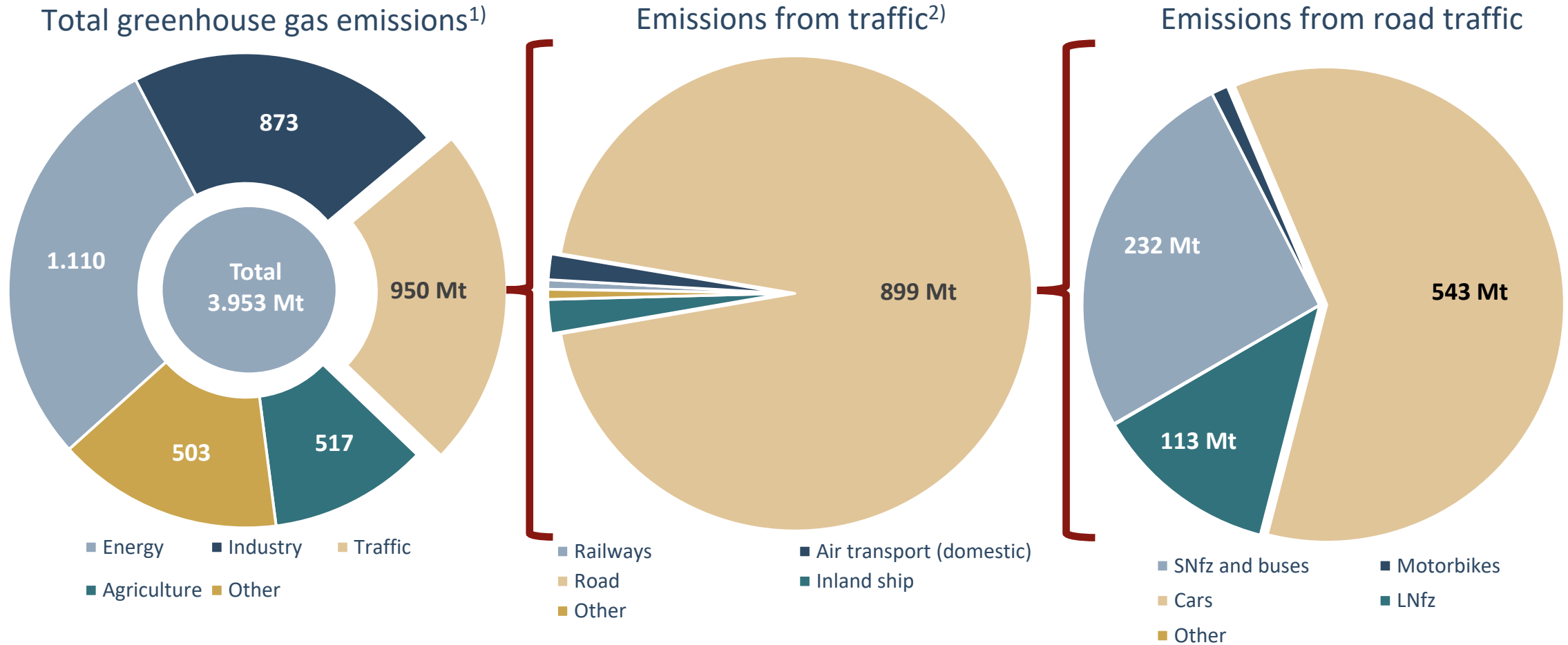
- ▶ Split development after the fall of the Iron Curtain.
- ▶ Emissions from traffic rose rapidly after 1990, as Eastern Europe was integrated into the European economic area. After 2007, emissions also fell in traffic, but rose visibly again from 2014 onwards. In 2018, emissions from traffic fell again for the first time.
- ▶ Industry and power generation realized huge savings in the early 1990s. Then their emissions stagnated until about 2007 and fell with the crisis.

Quelle: EEA, 2020 (v23)



# Road traffic plays a central role in Europe

Figures for the EU28 in 2018 in megatons CO<sub>2eq</sub>



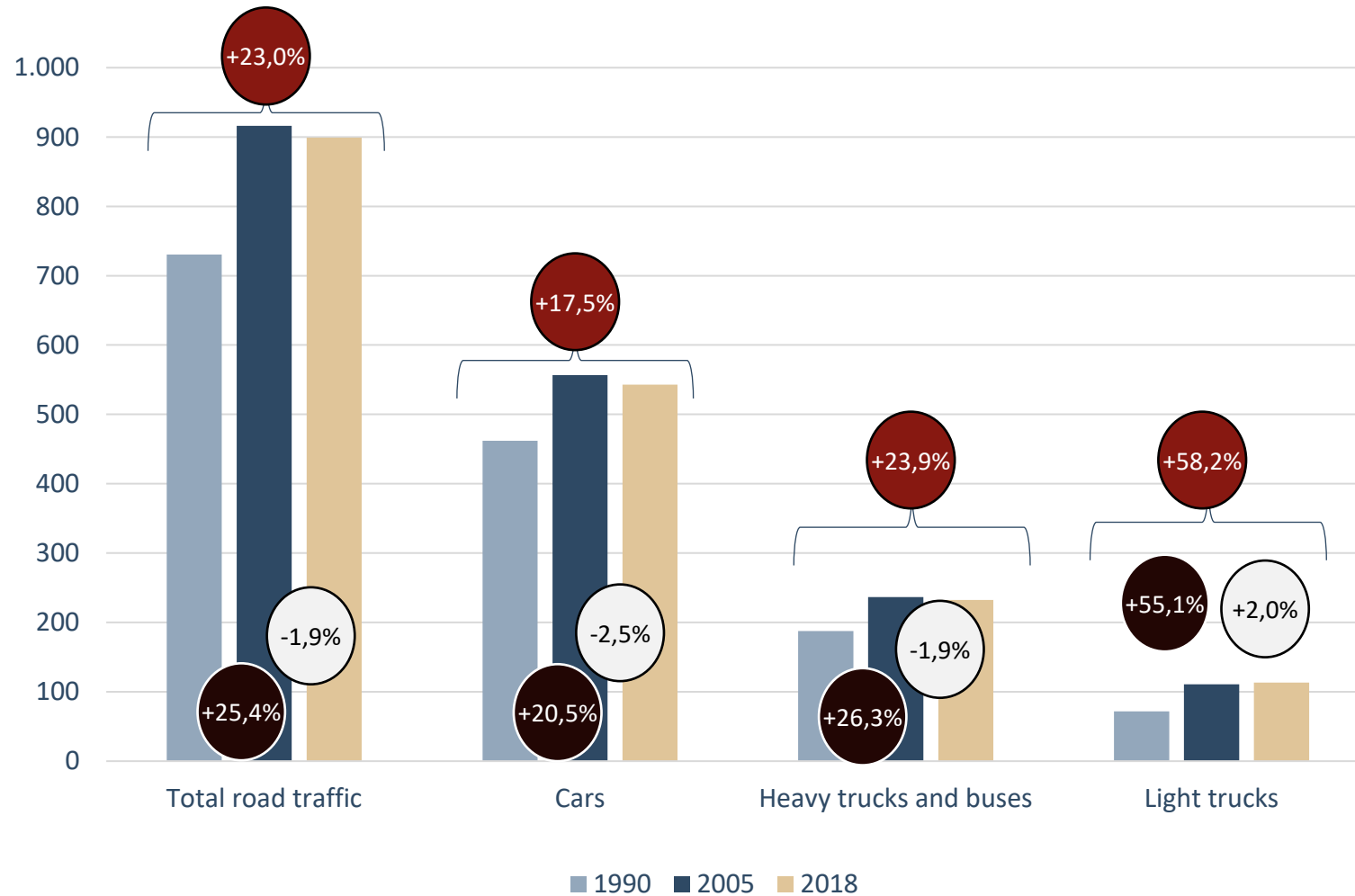
<sup>1)</sup> With sinks

<sup>2)</sup> Excluding international air and sea transport

Source: EEA, 2020 (V23)

# EU road traffic: Emissions growth especially in the 90s

In million tons CO<sub>2</sub>EQ

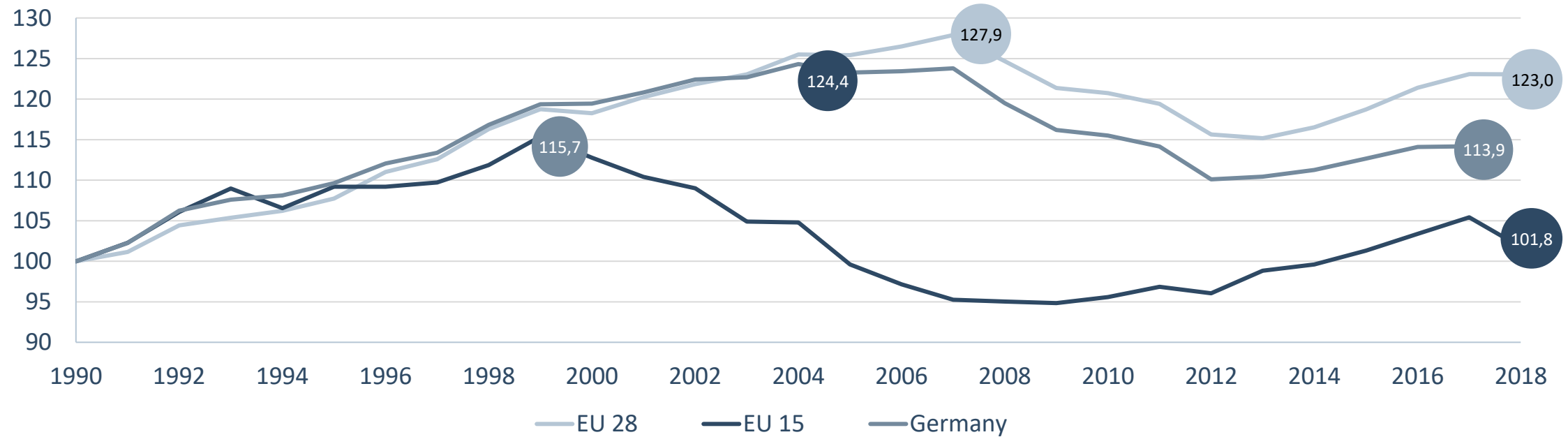


- ▶ The EU wants to reduce emissions from traffic by 30 percent between 2005 and 2030.
- ▶ EU road traffic emissions peaked in 2007.
- ▶ Between 2007 and 2013 CO<sub>2</sub> emissions from road transport in the EU fell. They have been increasing again since 2013.
- ▶ The greatest growth in emissions was recorded by light commercial vehicles, which, however, make up a relatively small proportion of total emissions.
- ▶ The growth in emissions in car traffic was more moderate. Emissions have stagnated since around 2004 and declined between 2007 and 2012. They have been rising again since 2013.

Source: EEA, 2020 (v23)

# Atypical course in Germany

CO<sub>2EQ</sub> emissions of road transport, 1990 = 100

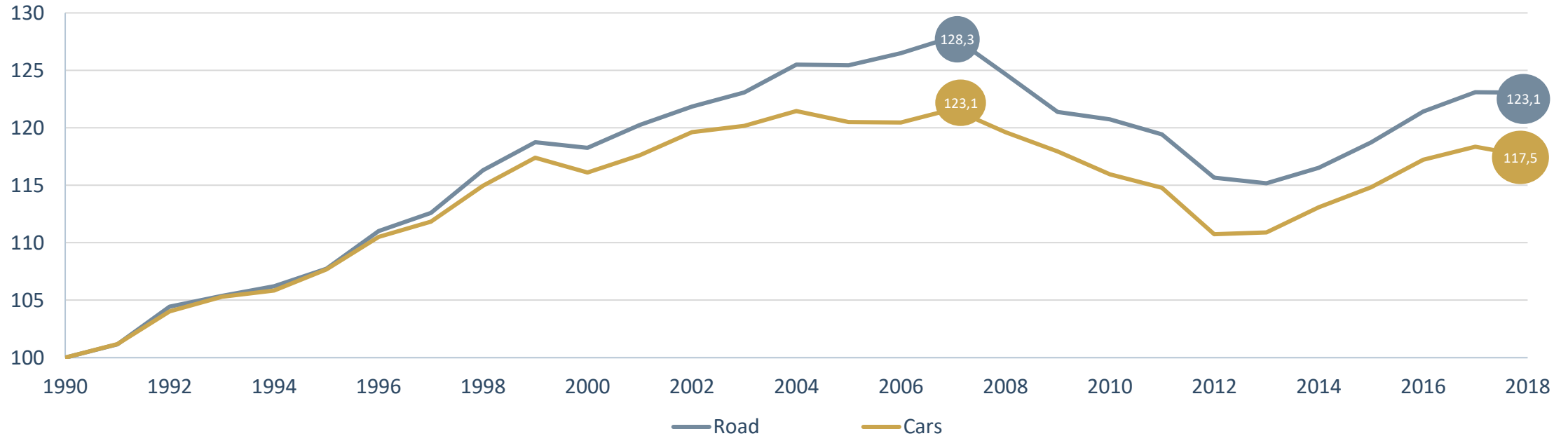


- ▶ In Germany, emissions fell by 24 million tons between 1999 and 2007. After that, they rose again and were at the level of 1990 in 2015. In 2018, emissions fell noticeably by almost 6 million tonnes. The strongest emission growth took place in the EU10.
- ▶ In the EU 28, the trend reversed only with the crisis in 2008. Emissions rose again from 2014.
- ▶ Between 2014 and 2017, emissions rose significantly again.

Quelle: EEA, 2020 (v23)

# Passenger car traffic in the EU: CO<sub>2</sub> emissions rise again

Absolute CO<sub>2EQ</sub> emissions, 1990 = 100

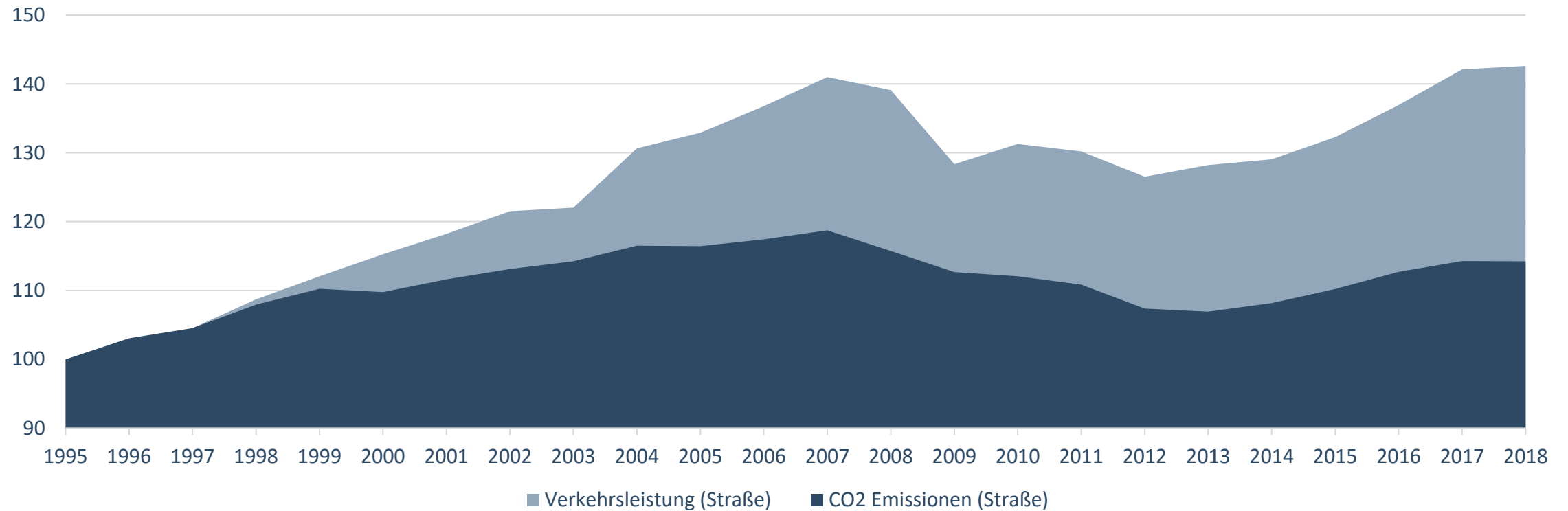


- ▶ Emissions from passenger cars have less risen than those from all road traffic. Significant reductions in emissions in 2011, but there is a rise since 2013.
- ▶ Passenger car emissions have largely stagnated since 2002 and collapsed in 2011, but have been rising again since 2013. Only in 2018 did the increase come to a standstill.

Source: EEA, 2020 (v23)

# Traffic growth dominates the balance sheet

Development of road transport performance and CO<sub>2</sub> emissions from road transport in the EU since 1995

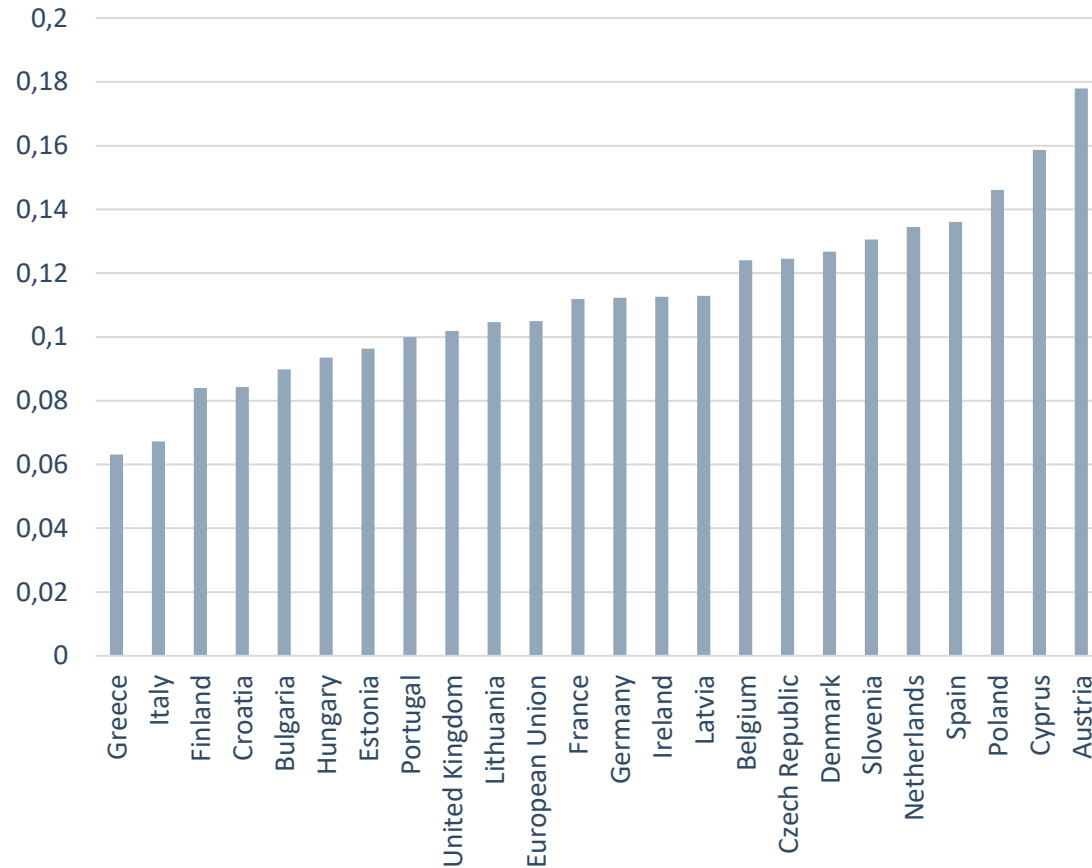


Calculation of traffic performance is analogous to the approach of the Arbeitsgemeinschaft Energiebilanzen with the Factor 1tkm = 10 pkm

Source: Odyssee Database, 2020; own calculations

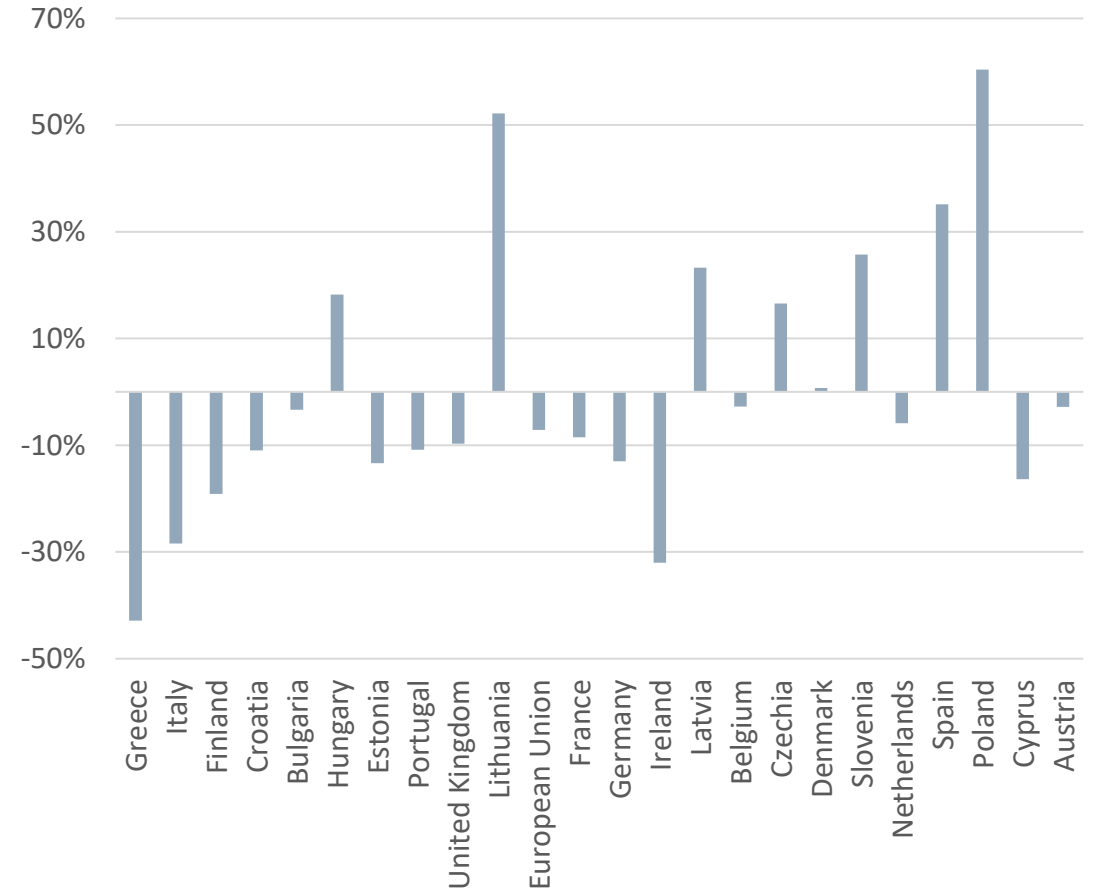
# CO<sub>2</sub> efficiency in passenger car traffic in the EU

CO<sub>2</sub> efficiency by states\* in the year 2018  
Measured in kg CO<sub>2</sub>/pkm



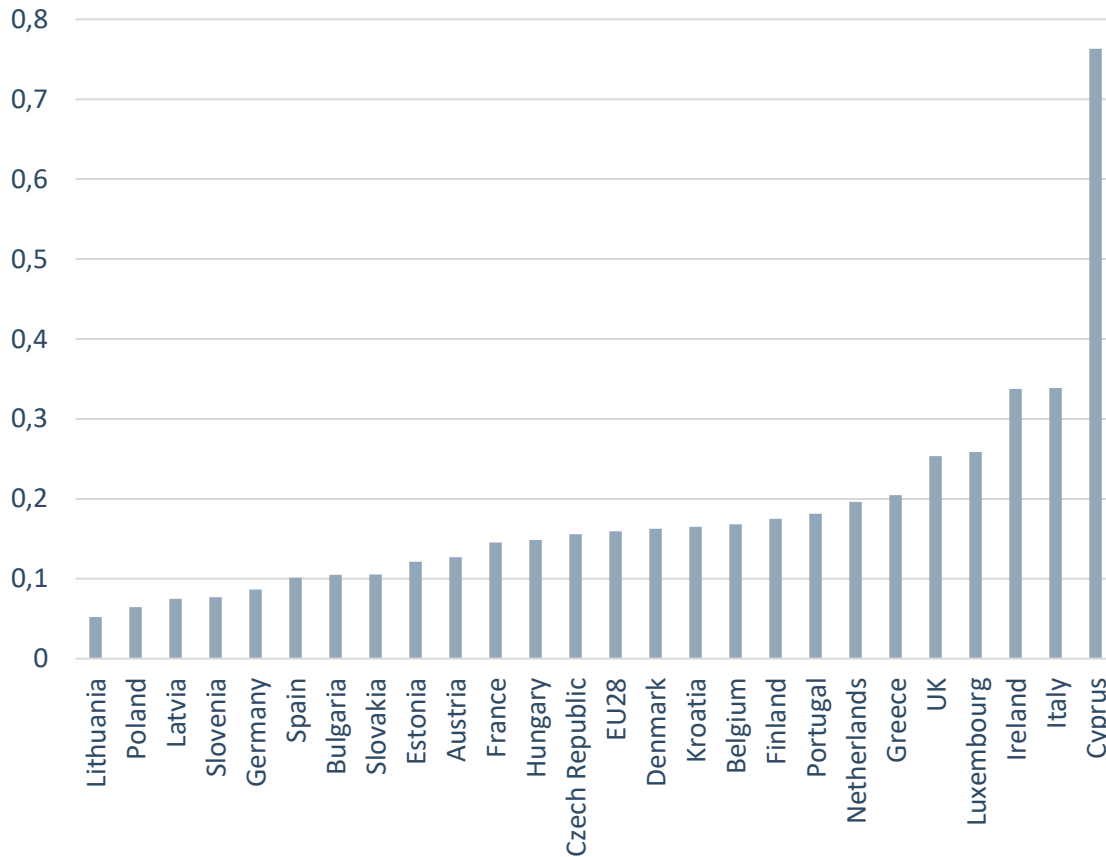
\*Belgium as of 2017; no information available for Luxembourg, Malta, Slovakia, Sweden  
Source: Odyssee Database, 2020

Change in CO<sub>2</sub> emissions per passenger kilometer  
Information for the period 2000 bis 2018

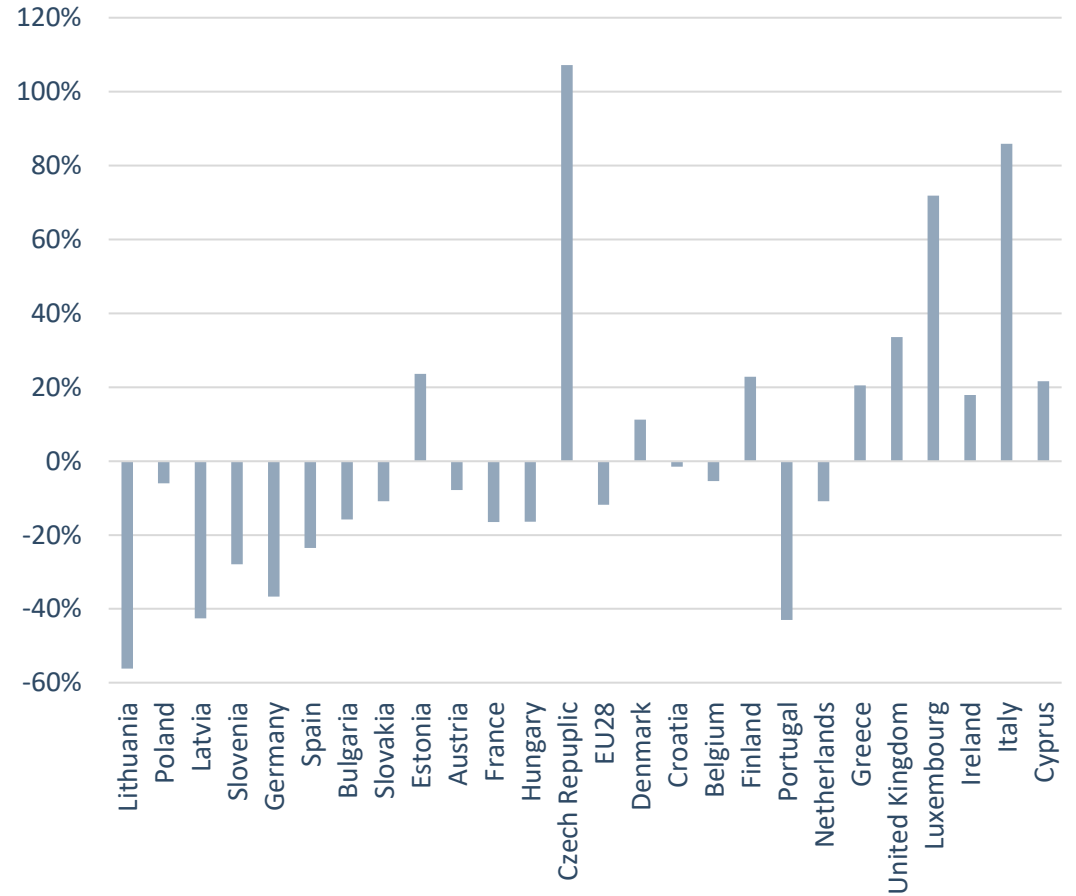


# CO<sub>2</sub> efficiency in road freight transport of the EU

CO<sub>2</sub> efficiency by states\* in the year 2018  
Measured in kg CO<sub>2</sub>/tkm



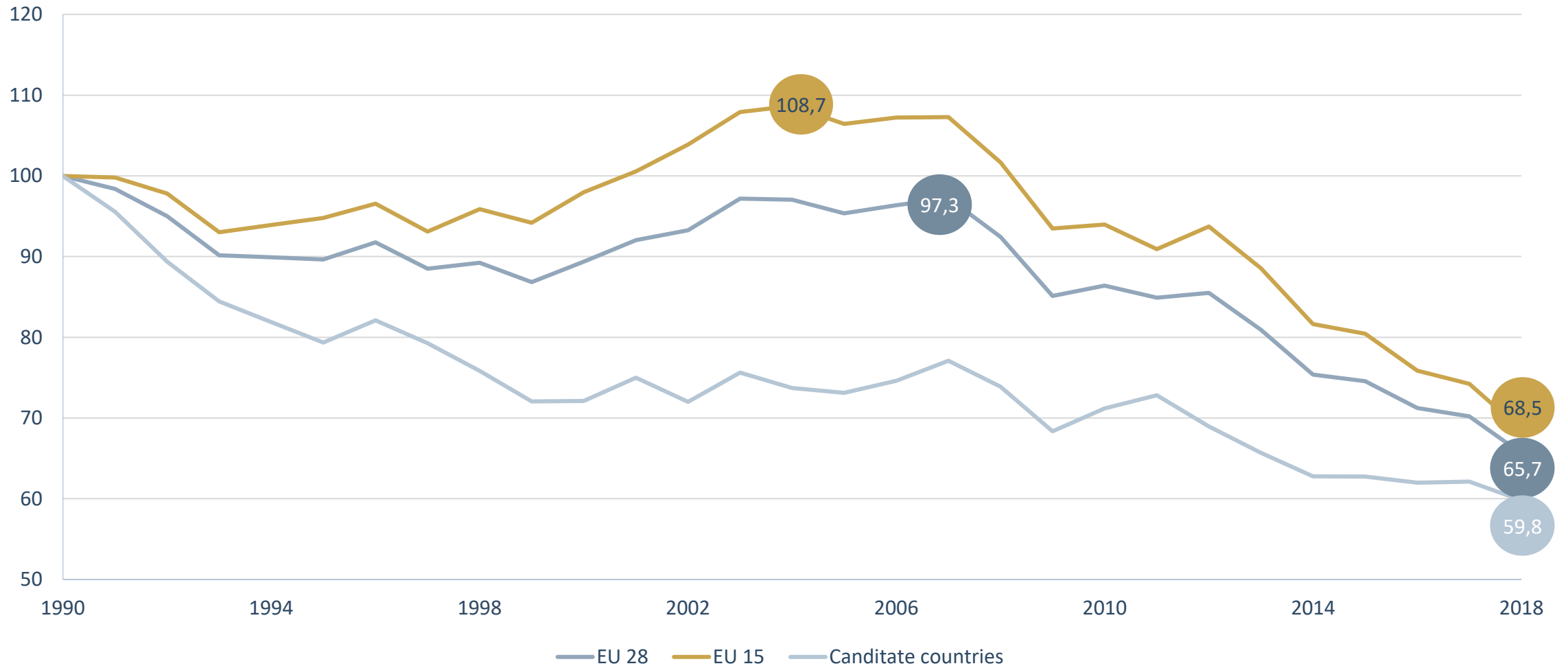
Change in CO<sub>2</sub> emissions in ton kilometres  
Data for the period from 2000 to 2018



\*Belgium as of 2017; No data available for Malta, Romania, Sweden  
Source: Odyssee Database, 2020

# Electricity: Stronger declines in the East, but the West is catching up fast

CO<sub>2EQ</sub> emissions of public electricity and heat generation, 1990 = 100



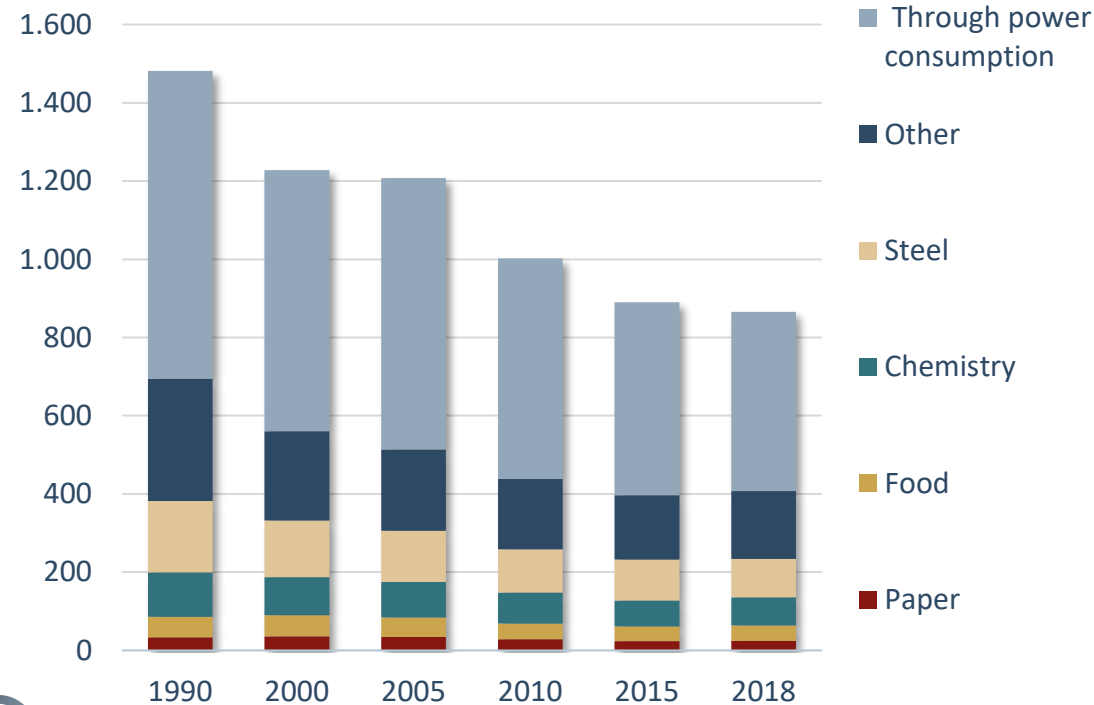
Source: EEA, 2020 (v23)



# Industry in the EU 28: Falling emissions, increasing efficiency

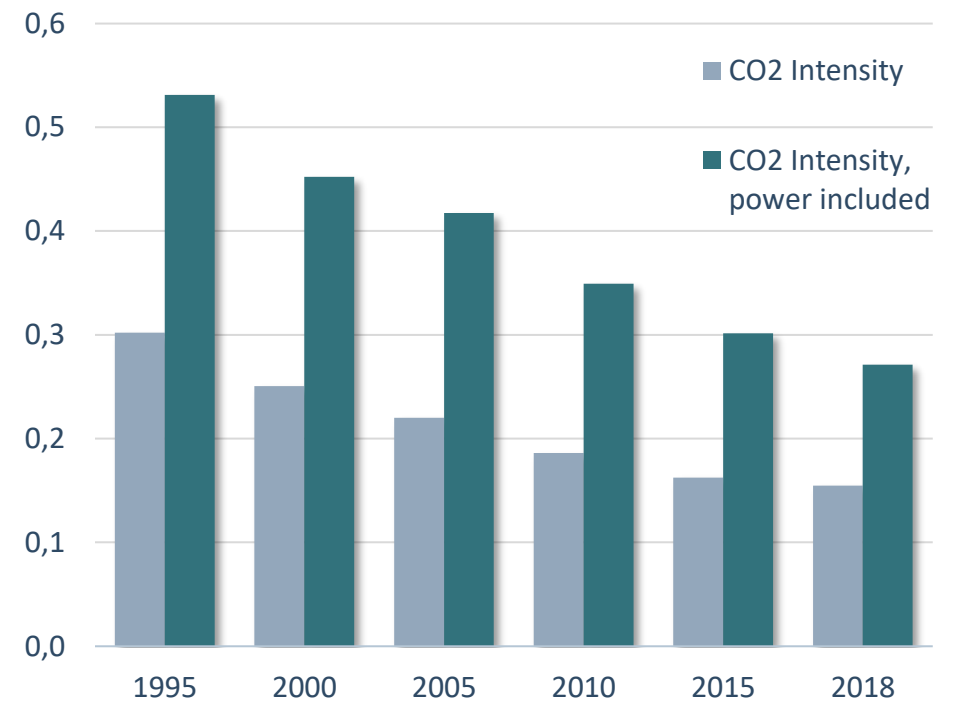
CO<sub>2</sub> emissions of the industry decrease: -25% since 1995

In million tons CO<sub>2</sub>



Halved since 1995: emissions per euro added value

kg CO<sub>2</sub>/Euro2010

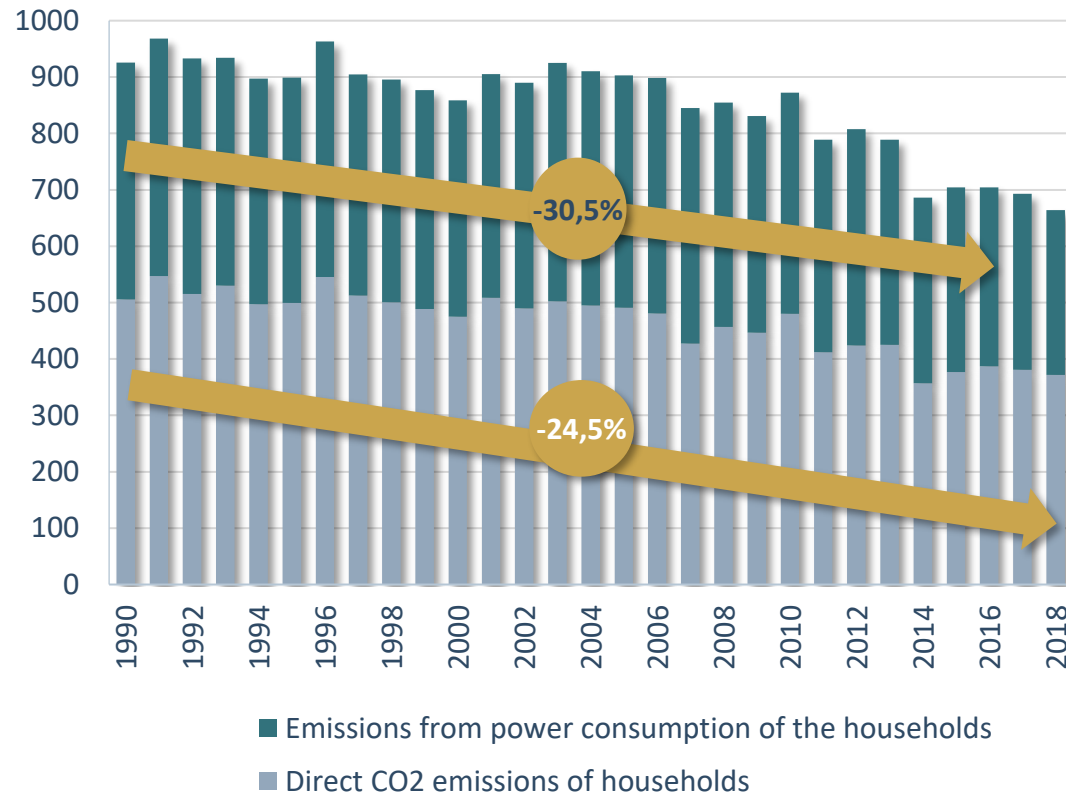


- ▶ Regulation: Most of CO<sub>2</sub> emissions caused by industrial activities falls under emissions trading.
- ▶ Efficiency increase: Emissions per unit of gross value added have fallen by a good 40 percent since 1995.
- ▶ De-industrialization: The migration of industry from many European countries reduced CO<sub>2</sub> emissions in the EU.

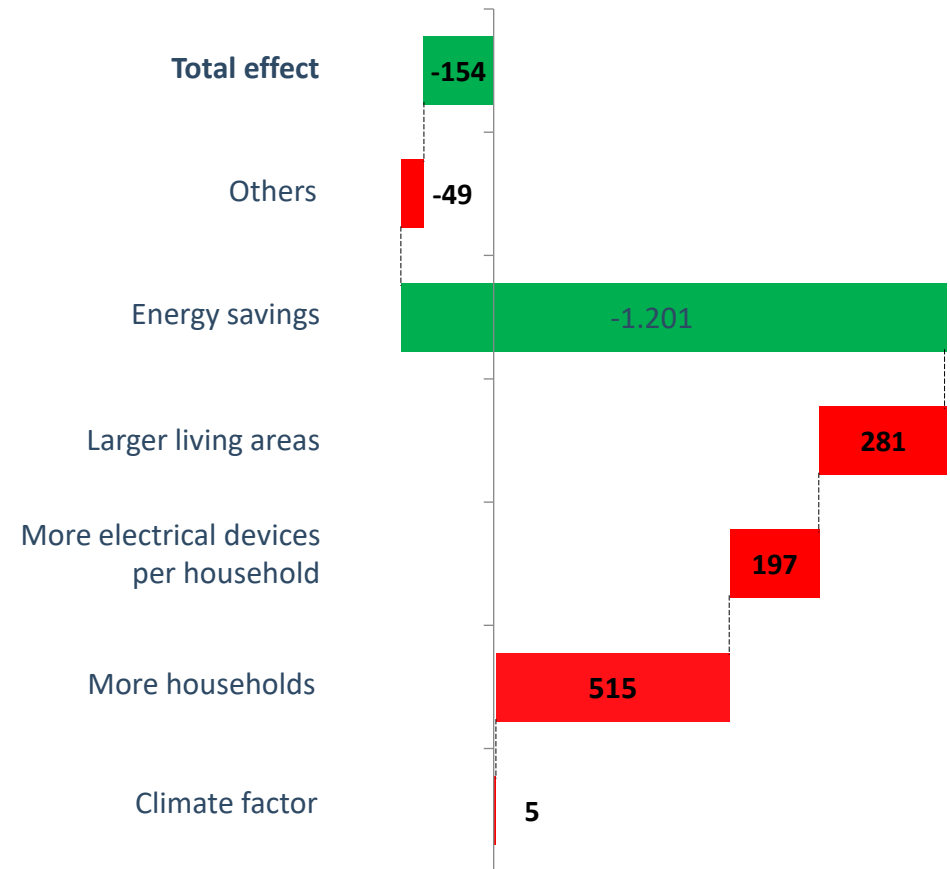
Source: Odyssee Database November 2020

# Households: Falling CO<sub>2</sub> emissions despite higher demands on housing

CO<sub>2</sub> emission of households in the EU28 since 1990  
Measured in million tons CO<sub>2</sub>



Change in energy consumption from 2000 to 2018  
Component setting, expressed in terawatt hours (TWh)



Source: Odyssee Database November 2020