Radiative forcing from European passenger vehicles emissions (1995-2015) based on real-world use

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the European „Diesel car boom“

Historic dieselization of the passenger car fleet in Europe

 Shares expressed as percentages, either of annual new car registrations or of the entire car fleet in different years. Data taken from Cames & Helmers (2013), and ACEA (2017)
Average type-approval CO₂-emissions of new cars in the EU

Sources: EU commission, European Environmental Agency; the geographical scope of the data changing from EU-15 through EU-28
From laboratory to road

Divergence between type-approval and real-world CO₂-emissions for passenger cars in the EU

Fuel consumption data collected from 7 European countries (web services like Spritmonitor.de, service providers, leasing/renting companies, fleet owners, automobile magazine tests)

- number of entries increased from 230,000 (2001) to 1.3 Mio (2015)
- number of sources increased from 2 (2001) to 6 (2015)

Source: Tietge et al. 2016, 2017
From laboratory to road

Divergence between type-approval and real-world CO₂-emissions for passenger cars in the EU

2007 first mandatory CO₂ regulation passed EU parliament; in force 2009

Based on data from Tietge et al., 2016
Average real-world CO$_2$-emissions of new cars in Europe.
Historic dieselization of the passenger car fleet in Europe, and DPF penetration rates

**CO$_2$-equivalents added due to BC emissions:**

GWP$_{20}$ = 3200
(270 – 6200)

GWP$_{100}$ = 900
(100 – 1700)

Bond et al. 2013

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**Euro 1**

Type approval: 140 mg PM/km

measured: 135 mg/km
corresponding 102 mg BC/km

→ 92 g CO$_{2e}$/km

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Adding the black carbon warming effect

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Shares expressed as percentages, either of annual new car registrations or of the entire car fleet in different years. Data taken from Cames & Helmers (2013), and ACEA (2017)
Historic dieselization of the passenger car fleet in Europe, and DPF penetration rates

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<thead>
<tr>
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<th>Euro 1*</th>
<th>Euro 2*</th>
<th>Euro 3*</th>
<th>Euro 4*</th>
<th>Euro 5*</th>
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<tbody>
<tr>
<td>CO(_2)-equivalents&lt;br&gt;added due to BC emissions:</td>
<td>92 g CO(_2)e/km</td>
<td>49 g CO(_2)e/km</td>
<td>17 g CO(_2)e/km</td>
<td>22 g CO(_2)e/km</td>
<td>0.4 g CO(_2)e/km</td>
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<td>GWP(_{20}) = 3200&lt;br&gt;(270 – 6200)</td>
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Adding the black carbon warming effect

Average GHG emissions of new cars in Europe including BC emissions

- Diesel cars EU real-world with BC effect
- Petrol cars EU real-world with BC effect
- Diesel cars EU real-world w/o BC effect
Adding the black carbon warming effect


Total committed lifetime emissions of CO₂ and total CO₂-equivalent (including black carbon), for 281 million new cars registered between 1995-2015 in the EU (each vehicle modelled with 200,000 km). Freezed* 1995 scenario: - 58 million diesel cars (*= diesel car percentages kept on 1995 level)
In 2014, 1.2 million used cars moved from Germany to other EU states, mainly to south-eastern Europe (Umweltbundesamt, 2016).

... destination of another 1.2 million used cars from 3.26 million cars which signed out in Germany in 2014 is unknown (Umweltbundesamt, 2016)

Assumptions:

a) 1/3 of all diesel cars move to Eastern Europe
b) they drive without DPF over 1/3 of their lifetime

⇒ This would cause an offset of +8 g CO₂-equivalents
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thank you for your attention

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