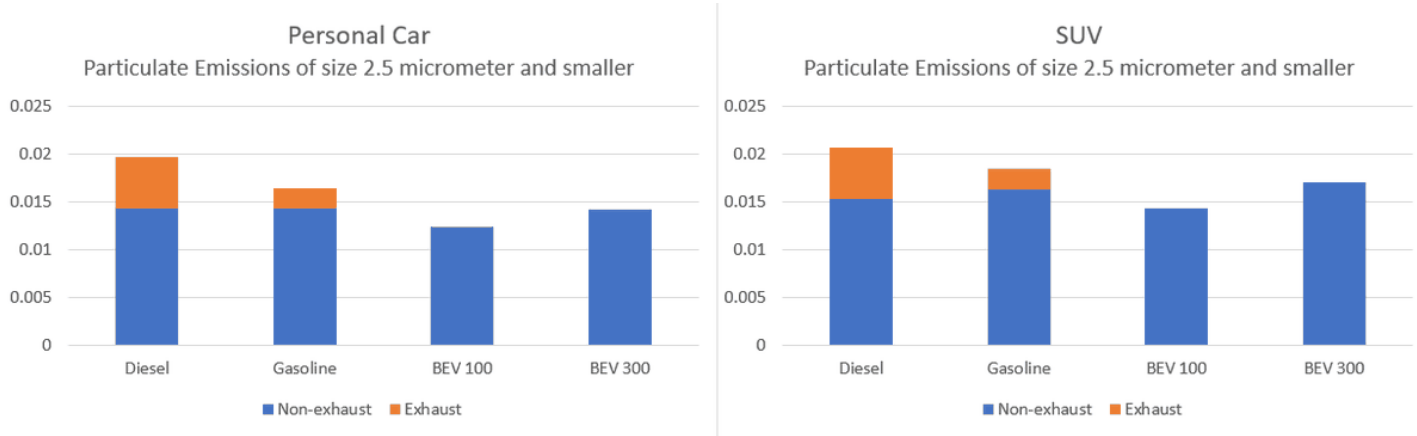
Twitter Thread by AukeHoekstra

AukeHoekstra
@AukeHoekstra

EVs DO NOT EMIT MORE PM

Recently @OECD published a report about particulate matter (PM) from road transport. Newspaper headlines blared that electric vehicles where worse than combustion vehicles. That conclusion was wrong according to the report itself.

Let me show you.



The report (published december 7) can be found here: https://t.co/1HpicKexOt

Non-exhaust Particulate Emissions from Road Transport

AN IGNORED ENVIRONMENTAL POLICY CHALLENGE

OECD

It's main point is well taken: as cars get cleaner, fine particles emitted by brakes, tires and road surfaces will become more important.

The table comparing electric and combustion engines is on page 92. I took averages of low and high values to get the graph

in the first tweet.

Table 3.4 PM2.5 emission factors across EURO-6-temp and BEV vehicle classes (g/vkm)

		PC				SUV				LCV			
		Diesel	Gasoline	BEV 100	BEV 300	Diesel	Gasoline	BEV 100	BEV 300	Diesel	Gasoline	BEV 100	BEV 300
Non-exhaust	low	0.0121	0.0121	0.0100	0.0115	0.0133	0.0133	0.0113	0.0135	0.0165	0.0165	0.0134	0.0164
	high	0.0165	0.0165	0.0147	0.0169	0.0193	0.0193	0.0174	0.0206	0.0226	0.0226	0.0200	0.0241
Exhaust (total)	low	0.0020	0.0017			0.0020	0.0017			0.0013	0.0013		
	high	0.0088	0.0026			0.0088	0.0026			0.0071	0.0020		
Primary		0.0015	0.0016			0.0015	0.0016			0.0009	0.0012		
Secondary													
SOA			0.0003				0.0003				0.0002		
SIA	low	0.0005	0.0001			0.0005	0.0001			0.0004	0.0001		
	high	0.0073	0.0010			0.0073	0.0010			0.0062	0.0008		
Total PM	low	0.0141	0.0137	0.0100	0.0115	0.0153	0.0150	0.0113	0.0135	0.0178	0.0178	0.0134	0.0164
	high	0.0253	0.0192	0.0147	0.0169	0.0281	0.0219	0.0174	0.0206	0.0297	0.0246	0.0200	0.0241
Percent non-exhaust	low	85.7%	87.8%			86.9%	88.9%			92.6%	92.9%		
	high	65.3%	86.3%			68.7%	88.2%			76.1%	91.9%		

I merely took the averages. To get this.

		Personal car				SUV			
		Diesel	Gasoline	BEV 100	BEV 300	Diesel	Gasoline	BEV 100	BEV 300
Non-exhaust	low	0.0121	0.0121	0.01	0.0115	0.0113	0.0133	0.0113	0.0135
	high	0.0165	0.0165	0.0147	0.0169	0.0193	0.0193	0.0174	0.0206
	average	**0.0143**	**0.0143**	**0.01235**	**0.0142**	**0.0153**	**0.0163**	**0.01435**	**0.01705**
Exhaust	low	0.002	0.0017			0.002	0.0017		
	high	0.0088	0.0026			0.0088	0.0026		
	average	**0.0054**	**0.00215**			**0.0054**	**0.00215**		
Primary	**average**	**0.0015**	**0.0016**			**0.0015**	**0.0016**		
Secondary SOA	**average**	**0.00345**	**0.0003**				**0.0003**		
Secondary SIA	low	0.0005	0.0001			0.0005	0.0001		
	high	0.0073	0.001			0.0073	0.001		
	average	**0.0039**	**0.00055**			**0.0039**	**0.00055**		
Total PM	low	0.0141	0.0137	0.01	0.0115	0.0153	0.015	0.0113	0.0135
	high	0.0253	0.0192	0.0147	0.0169	0.0281	0.0219	0.0174	0.0206
	average	**0.0197**	**0.01645**	**0.01235**	**0.0142**	**0.0217**	**0.01845**	**0.01435**	**0.01705**

I think it is a terrific report that pulls together a LOT of literature on fine particles that cars spew into the air and that make us sick.

We have ignored this problem for too long, and there's more here than simply exhaust!

I have just two gripes with the article:

1) Electric vehicle weight
It estimates batteries at 10 kg/kWh when in reality it's already below half of that. So it makes electric vehicles much too

heavy and doesn't take into account that in 2030 they will be much lighter still.

2) Simply comparing grams
We know that the stuff that comes out of the exhaust pipe is really bad for your health.

How that compares to sand and rubber from the road (gram for gram and particle for particle) is still completely unclear. They state this clearly themselves.

We know that a lot of the stuff in there can be bad for your health (see table).

But how much is how bad and what is the impact of particle size? For the stuff that's not from the exhaust we basically have no idea.

Table 2.7. Health effects of non-exhaust tracers concentrations and source contributions

Exposure indicator	Mortality		Morbidity		Other symptoms/biomarkers
	Short-term	Long-term	Short-term	Long-term	Long-term
Copper	All-cause, respiratory and ischemic heart disease	All-cause, cardiovascular and ischemic heart disease	Cardiovascular and respiratory	Lung cancer, carotid intima-media thickness	Low newborn's size and inflammatory marker
Zinc	All-cause, cardiovascular, respiratory and ischemic heart disease	All-cause, cardiovascular and ischemic heart disease	Non-accidental, cardiovascular and respiratory	Pneumonia and lung cancer	Lung function, low newborn's size and inflammatory marker
Iron	All-cause, cardiovascular, respiratory and ischemic heart disease	All-cause, cardiovascular and ischemic heart disease	Cardiovascular and respiratory	Cardiovascular and lung cancer	Lung function, blood pressure, low newborn's size and inflammatory marker
Silicon	All-cause, cardiovascular and respiratory	All-cause, cardiovascular, respiratory, pulmonary and ischemic heart disease		Cardiovascular	Blood pressure and low newborn's size
Calcium	All-cause, cardiovascular and respiratory	Respiratory	Non-accidental, cardiovascular and respiratory		
Barium	Cardiovascular and respiratory		Non-accidental and respiratory		
Antimony	Cardiovascular and respiratory		Non-accidental and respiratory		
Source contributions	All-cause and cardiovascular	All-cause		Myocardial infarction and Preeclampsia	Respiratory

These studies about road dust are the closest the report comes to quantifying this but as you can see it's a mess.

Table 2.6. Overview of findings of epidemiological studies using source apportionment analysis

Study	Country	Period	Health outcome	Non-exhaust source	Increased risk (95% confidence interval) per increase of non-exhaust PM	Increased risk (95% confidence interval) per increase of exhaust PM
Ostro et al. (2011[108])	Spain	2003-2007	Short-term total mortality	Road dust (PM2.5)	4.2% (1.5-7.0%) per 1.8 µg/m3	3.7% (0.7-6.7%) per 5.2 µg/m3
				Road dust (PM10)	No effect	3.6% (0.1-7.2%) per 5.2 µg/m3
			Short-term cardiovascular mortality	Road dust (PM2.5)	6.7% (2.4-11.3%) per 1.8 µg/m3	No effect
				Road dust (PM10)	No effect	6.4% (1.5-11.6%) per 5.2 µg/m3
Kioumourtzoglou et al. (2014[118])	MA, USA	2003-2010	Short-term cardiovascular emergency visits	Road dust (PM2.5)	No effect	1.44% (0.02- 3.11%) per 1.1 µg/m3
Tonne et al. (2016[111])	UK	2003-2010	Long-term all-cause mortality	Non-exhaust contribution (PM10)	5% (0-10%) per 1.1 µg/m3	No effect
				Non-exhaust contribution (PM2.5)	4% (0-9%) per 0.3 µg/m3	No effect

Even how vehicle characteristics influence PM is only very vaguely know.

Table 2.8. Overview of the influence of vehicle, driving and road features and weather conditions on non-exhaust emissions

	Brake wear	Tyre wear	Road wear	Resuspension
Vehicle features				
Rotor temperature	↑			
Vehicle size	↑	↑	↑	↑
Vehicle weight	↑	↑	?	?
Metal content in brake pads	↑			
Studded tyres		↑	↑	↑
Tyre diameter		↓		
Tyre width		↓		
Tyre tread depth		–		
Vehicle undercarriage				?
Tyre rolling resistance		?	?	
Tyre tread wear rating		–		
Mileage	?	↓		
Road features				
Allowed max speed	↑	↑	↑	↑
Allowed max weight	↑	↑	↑	↑
Pavement age/state		?	↑	↑
Resistant ballast rocks		↑	↓	?
Size of stones for road pavement conglomerate			↓	↓
Asphalt porosity		?	?	↓
Rubber asphalt		?	?	?

So for me the summary:

We know particles emitted from the road and the wheels of cars make us sick but that's about it. More research is urgently needed so we can avoid millions of deaths.

And there is a LOT we can do!

By switching to electric vehicles we are probably eliminating some of the most harmful emissions (from tailpipes and brake pads).

We could try to make tires more wear resistant (probably not a top priority of manufacturers).

We can find out what materials in tires are worst and leave them out.

We can construct roads in a way that traps part of the particles or we might even vacuum them up before they are released out into the open.https://t.co/mxA62vhuDG

A group of Imperial students have won this year's James Dyson Award for their device to curb microplastic emissions from vehicle tyres.

Most importantly we should use lighter cars. So a monster like this Cybertruck certainly doesn't make your neighborhood safer or healthier.

Bottom line: electric cars are less bad for the climate and air quality than regular cars, but once they eliminate tailpipe and brake pad emissions we should focus on emissions from tires and roads. And that's almost virgin territory. Time to get to work on that!