EMISSIONS ANALYTICS

Rating, labelling and taxing cars in an electrified world

A manifesto for radical simplification

Nick Molden
Founder & CEO, Emissions Analytics
Honorary Senior Research Fellow, Imperial College London

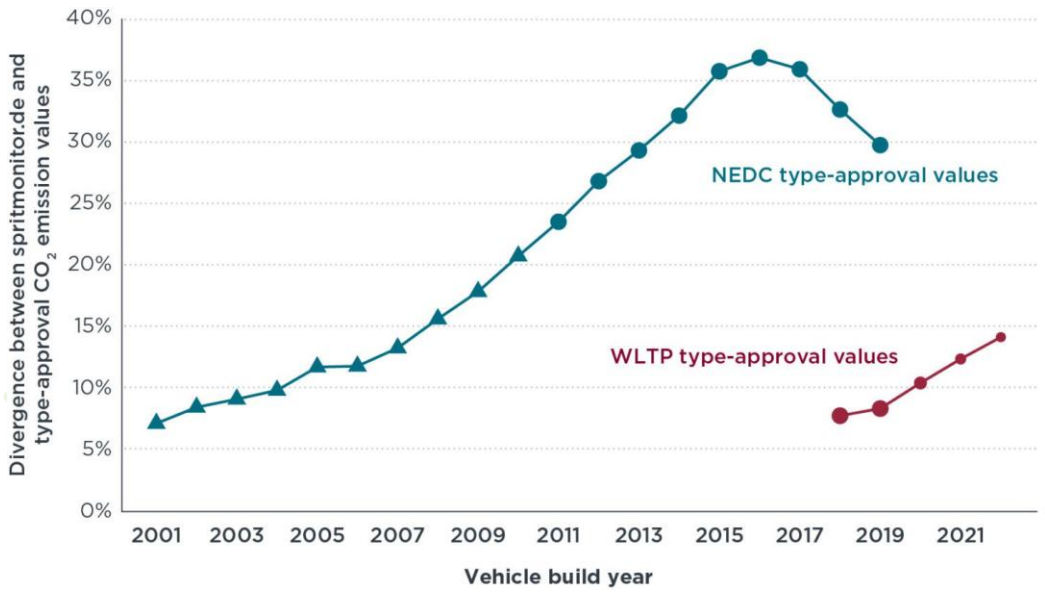
12 March 2025

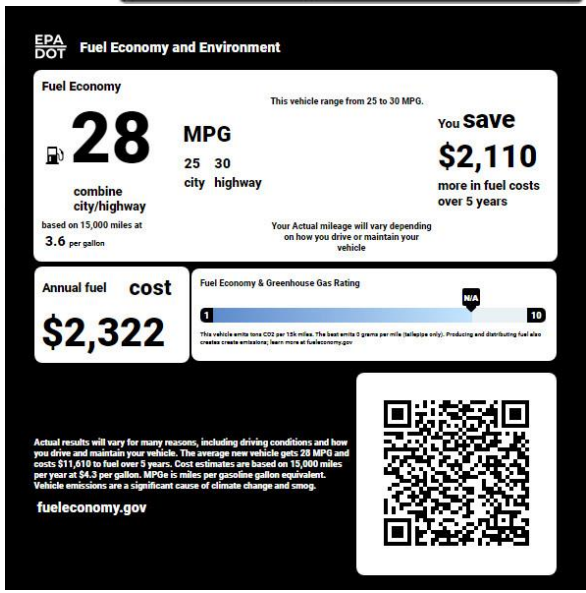
ASSURED | INDEPENDENT | RESPONSIVE

Intuitively, this can’t be the environmental solution

Car ratings and labelling

- Simplicity
- Accuracy
- Comprehensiveness



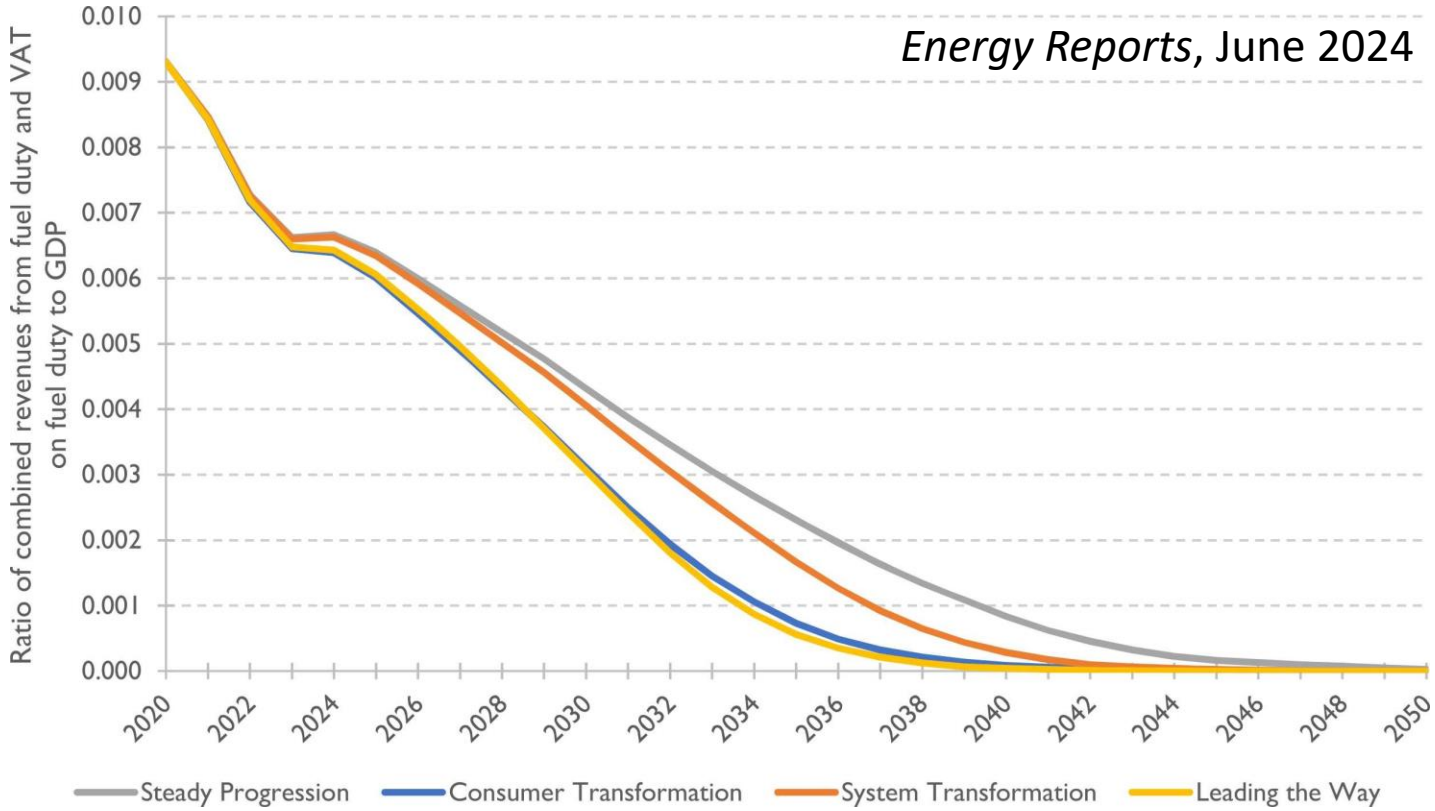


EMISSIONS ANALYTICS

Taxation problem

- Complex
- Blurred incentives
- But hard to cheat

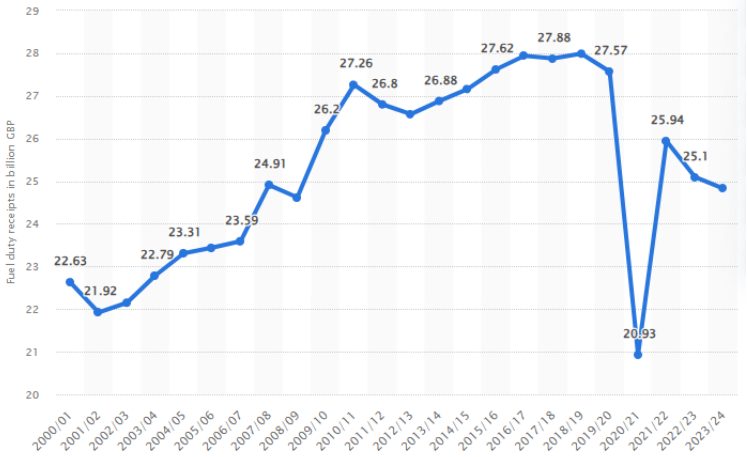
- Declining revenues as we electrify!



Current state of play

- Big cars pretending to be low emission
- Labelling not working
  - Green NCAP methodology has 9 documents
  - 376 pages
- Tax revenues going down

TEST PROCEDURE
Overall Test Procedure



EMISSIONS ANALYTICS

Most people want to do the right thing when buying a car

- Broad supporting for tackling climate change
- People are thoughtful but practical
- Interventions have to be fair, justified and cost-effective
- Willingness to pay 9.7% sustainability premium (PwC)

EMISSIONS ANALYTICS

But this is increasingly the reality

EMISSIONS ANALYTICS

And the data back it up

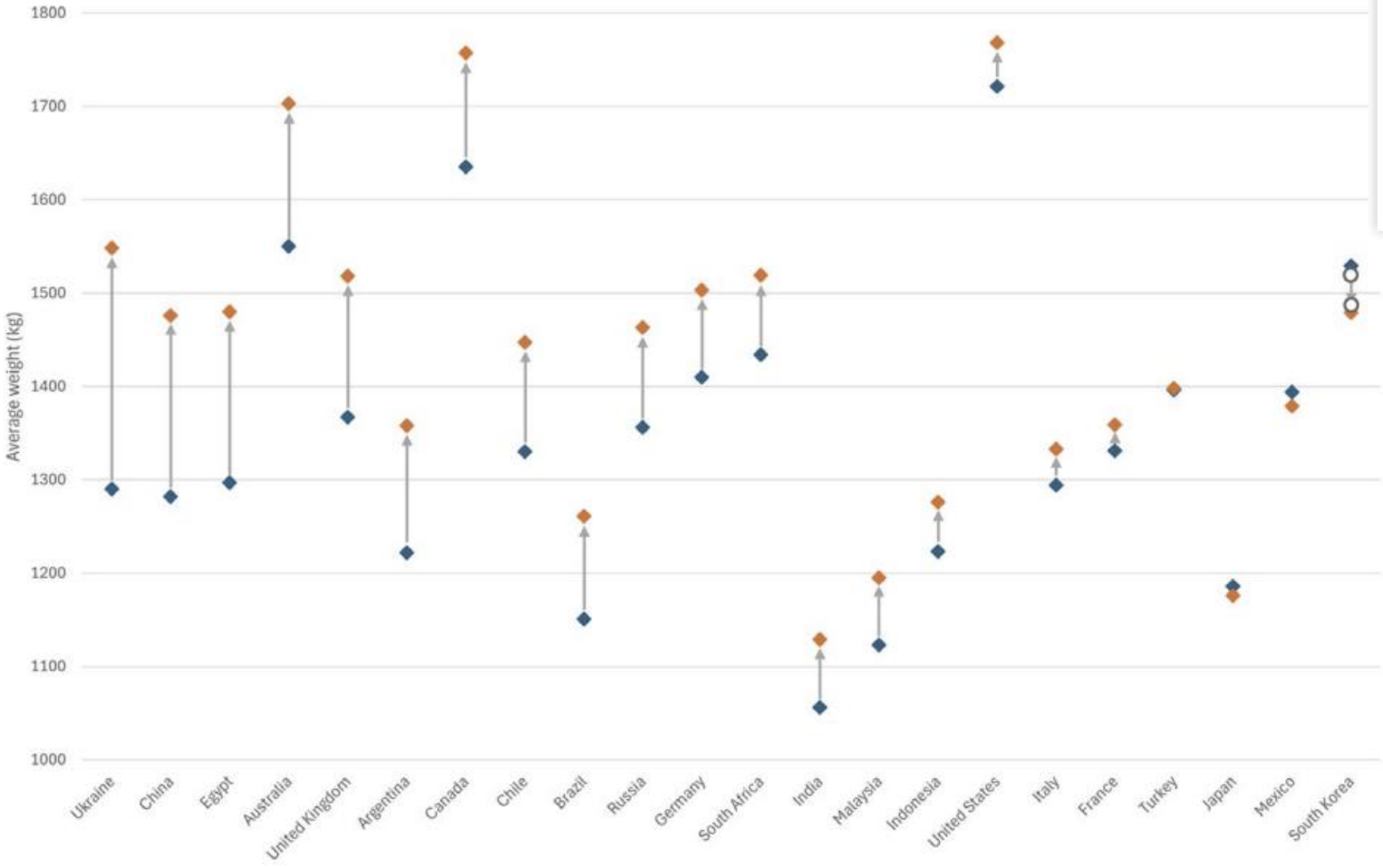
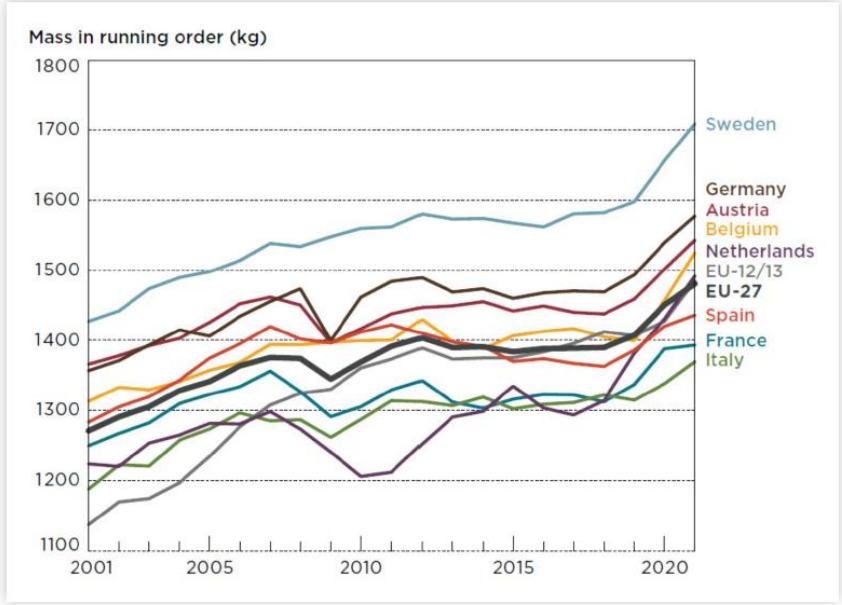


FIGURE 1.3 Average vehicle masses in the EU by country 2001–2021 [1.26].

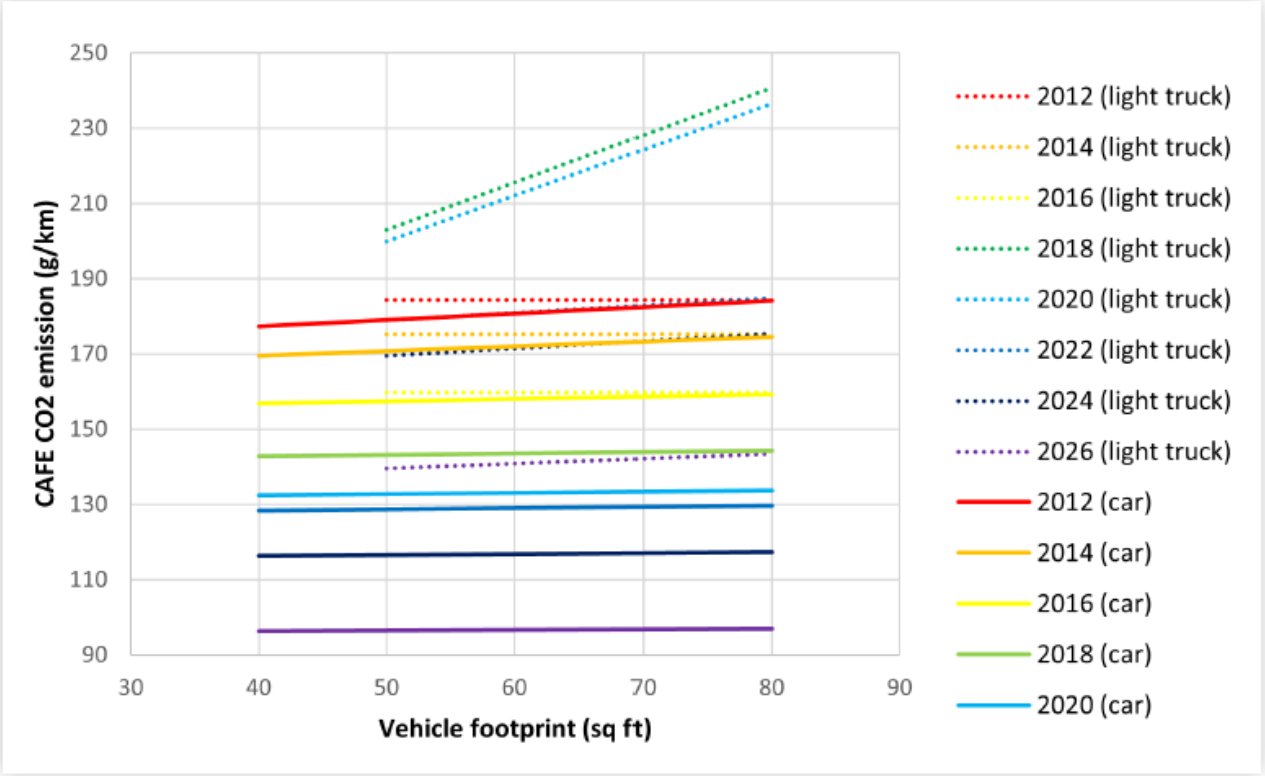


- Trend in average car weight by country

Perverse incentives

- Easier CO_2 target for bigger cars in the US
- Gentler treatment for pickups
- EU CO_2 targets have been adjusted depending manufacturers' product portfolios

FIGURE 11.3 CAFE carbon dioxide standards with respect to vehicle size [11.13, 11.14].



EMISSIONS ANALYTICS

A thought experiment

If you could know only *one* piece of information to estimate the total environmental impact of your vehicle, and to compare that impact to other vehicles, what would it be?

Is That Even Possible?

EMISSIONS ANALYTICS

Is that even possible?

- It is *impossible* to create some index or ratings system that incorporates *every* aspect in which a vehicle impacts the environment
- How do you weigh different dimensions?
- What might *good enough* look like?

EMISSIONS ANALYTICS

So many factors

EMISSIONS ANALYTICS

The winner

If you could know only *one* piece of information to estimate the total environmental impact of your vehicle, and to compare that impact to other vehicles, what would it be?

Mass. Nothing else comes close

$$\text{Work done} = \text{Force} \times \text{Distance}$$

EMISSIONS ANALYTICS

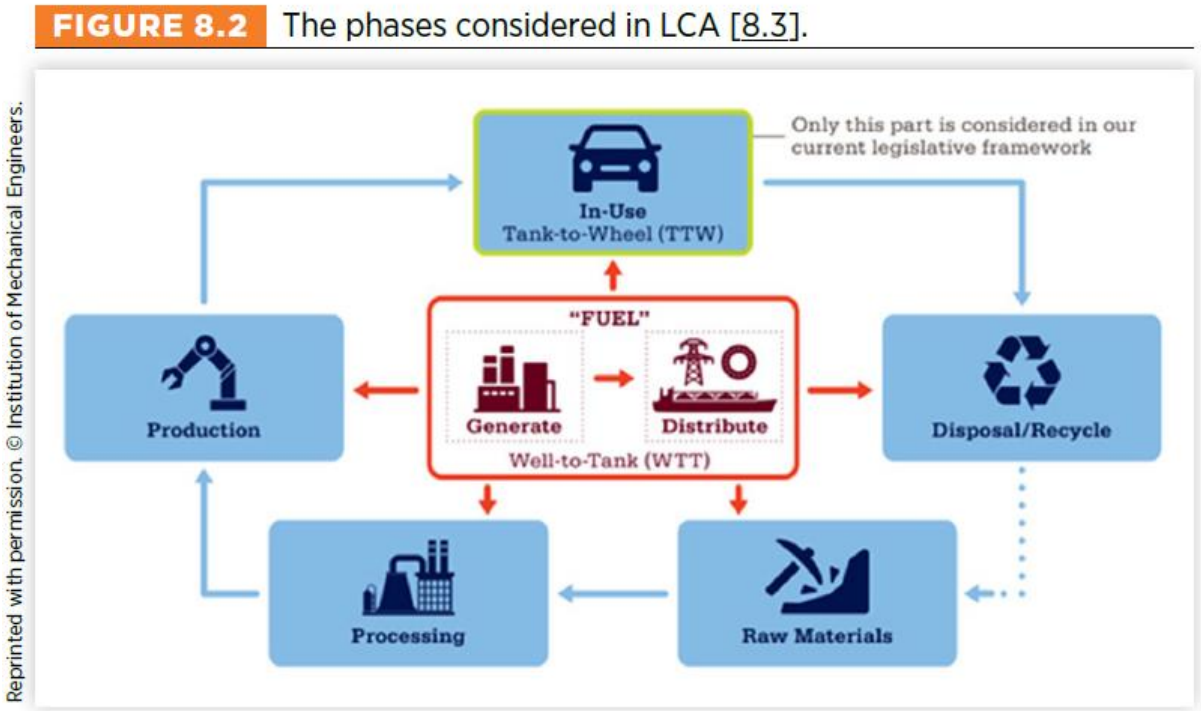
The *Molden-Leach Conjecture*

$$\text{Environmental impact} = \text{Vehicle mass} \times \text{Annual distance traveled}$$

EMISSIONS ANALYTICS

Testing the conjecture: lifecycle production

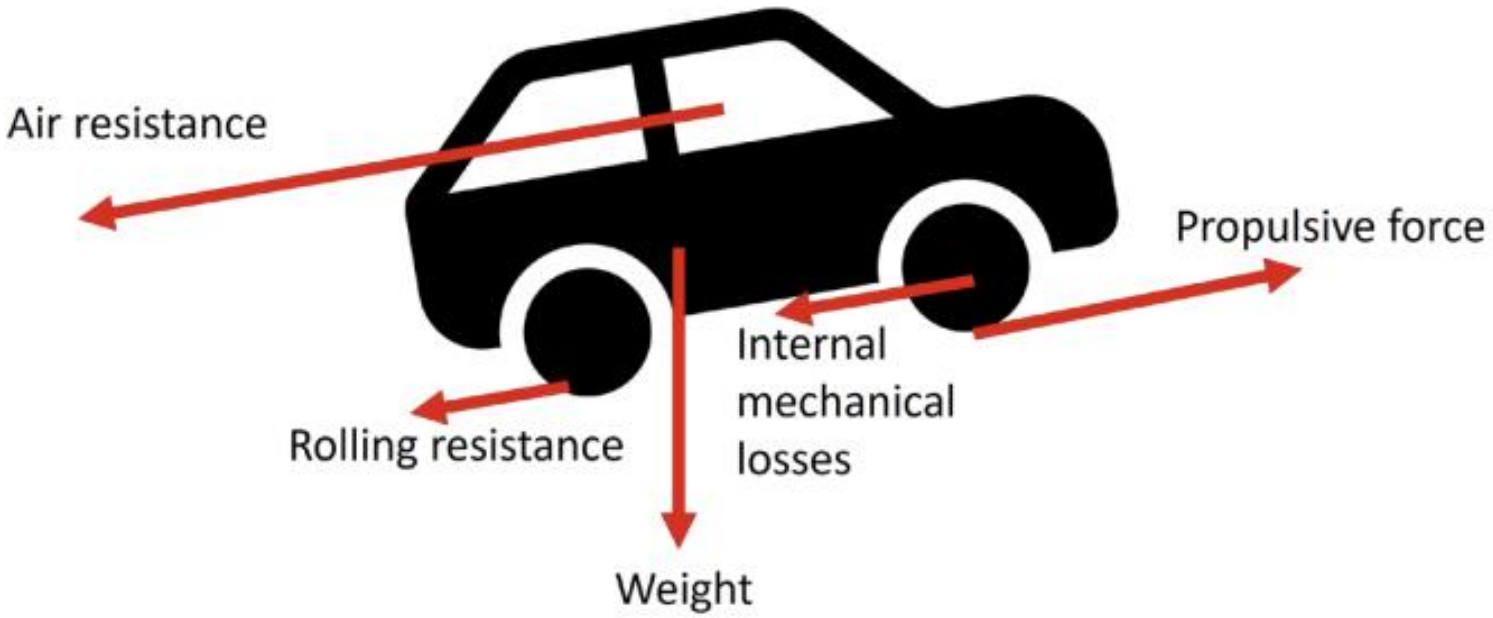
- Glider ✓
  - Some practical constraints on undesirable materials
- Energy store
  - BEV ✓, FCEV ✓, ICEV no link
- Powertrain no link
- NB – GREET and other LCA models have vehicle mass as the denominator



EMISSIONS ANALYTICS

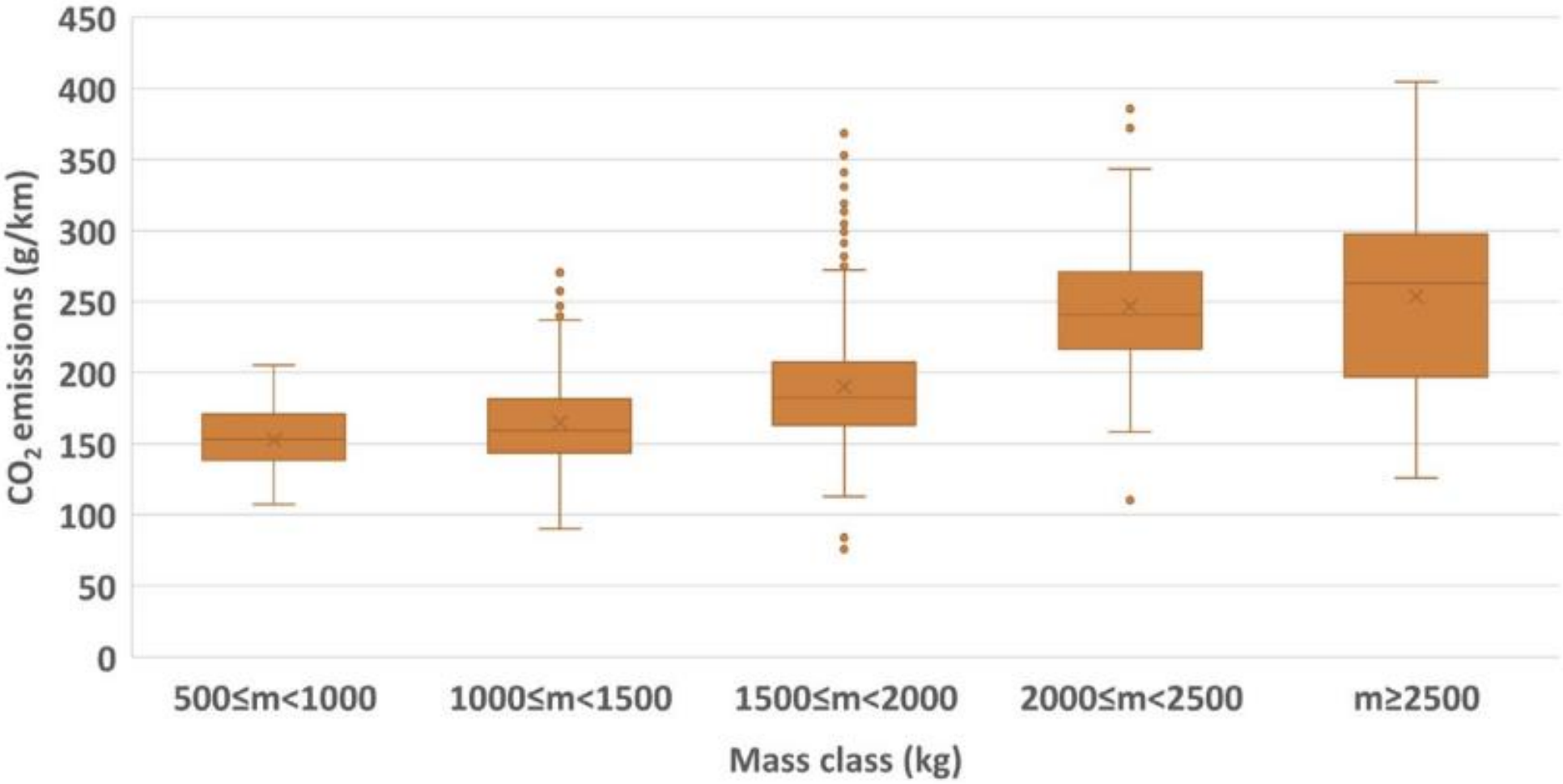
Testing the conjecture: lifecycle in-use

- Most elements linked clearly to mass, but other possibilities are…
- Vehicle size
- Torque



EMISSIONS ANALYTICS

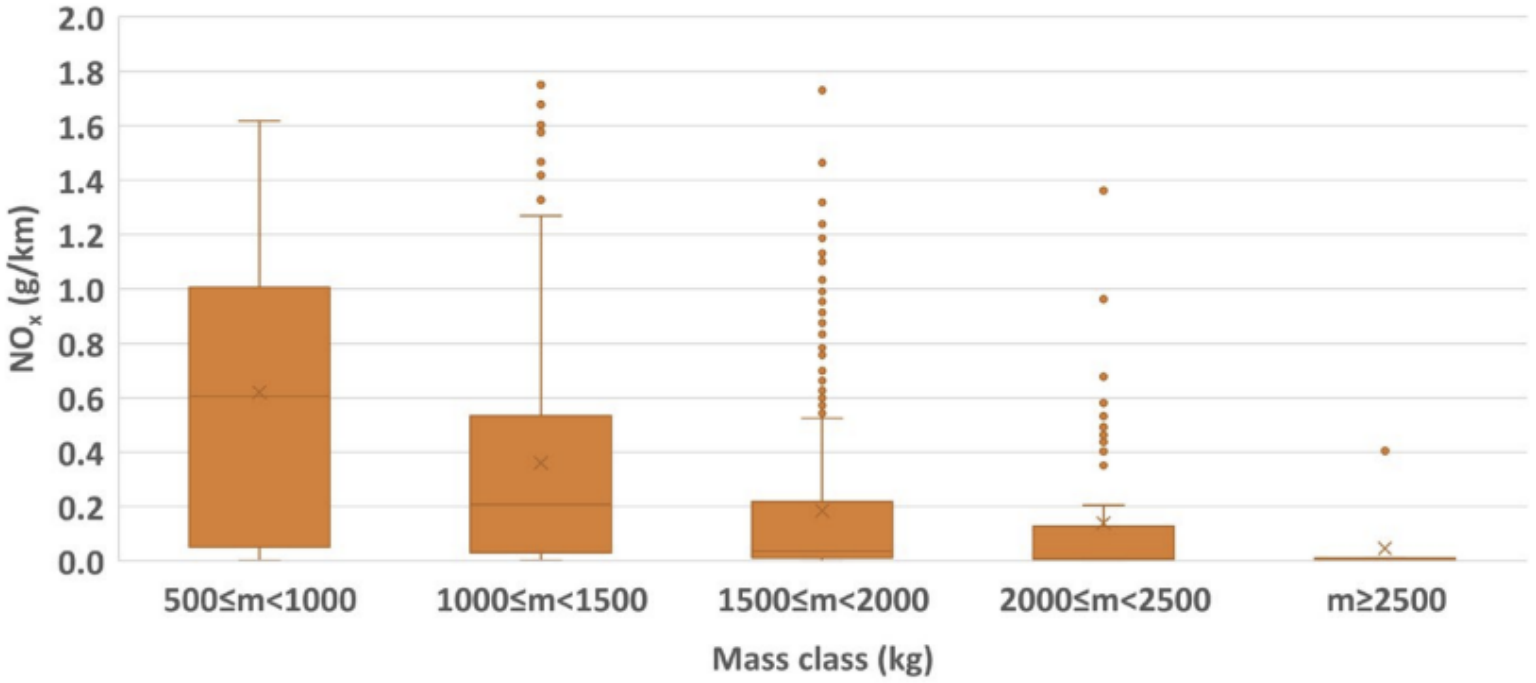
Testing the conjecture: in-use CO_2



EMISSIONS ANALYTICS

Testing the conjecture: in-use NO_x

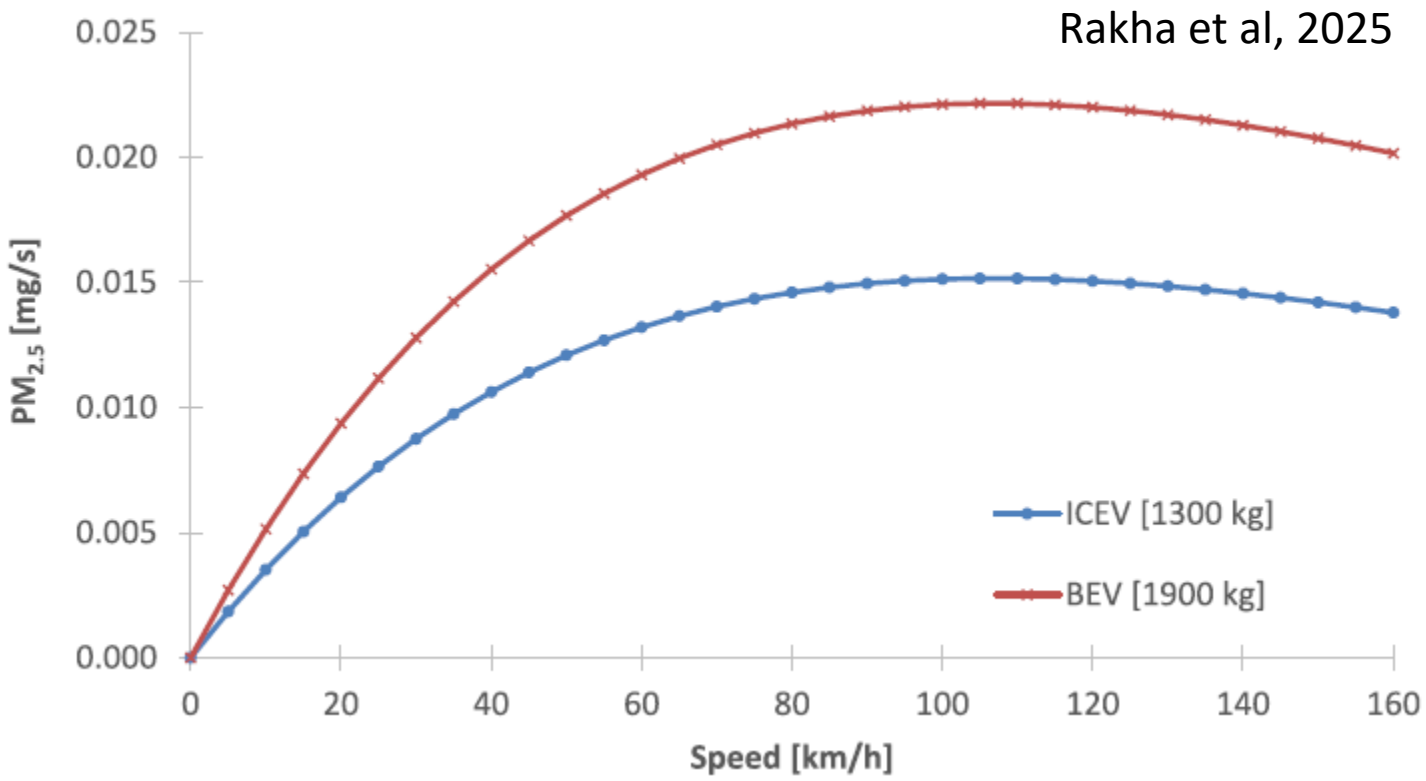
- Inverse relationship with mass
- But absolute levels inconsequential since 2018
- Carbon monoxide similar



EMISSIONS ANALYTICS

Testing the conjecture: non-exhaust

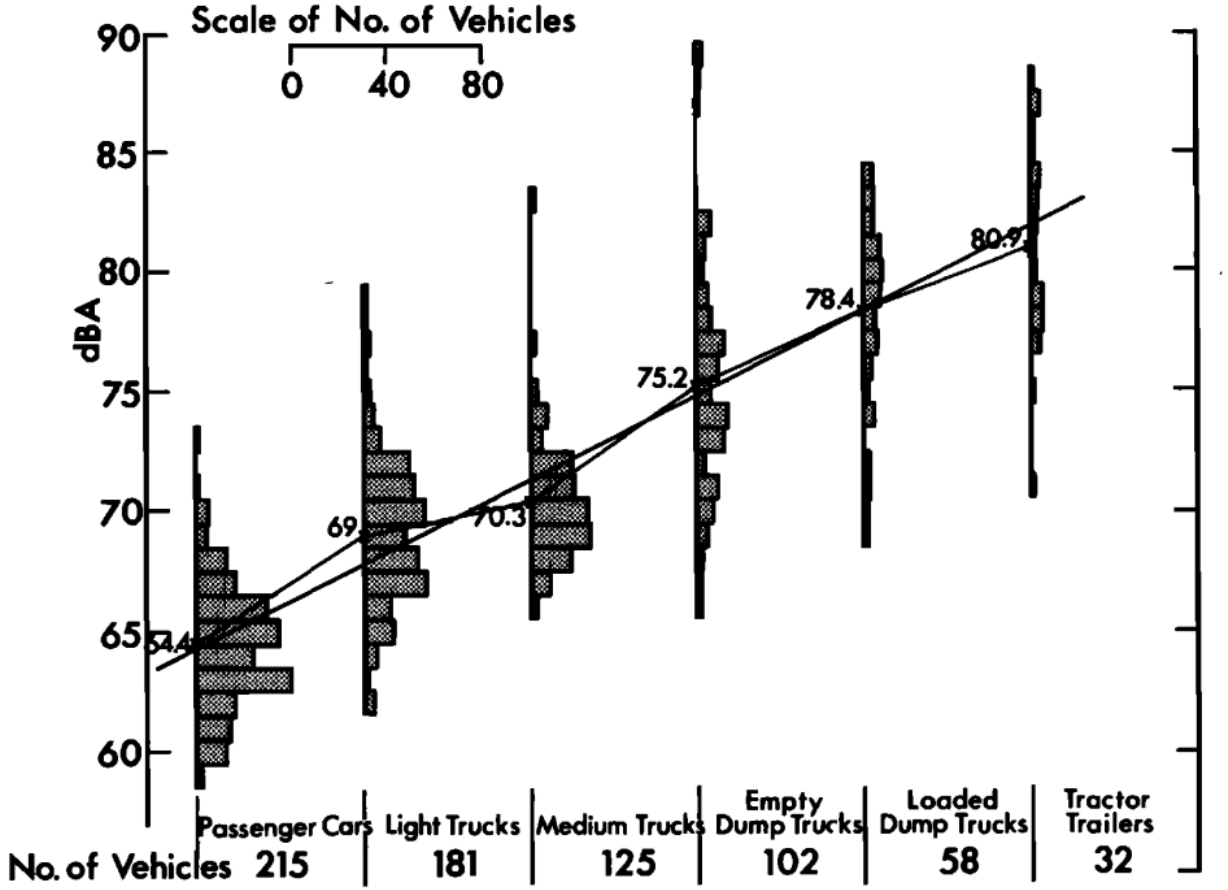
- Tyre wear strongly related to weight
- But less so for brakes
- Presence of regenerative braking matters more



EMISSIONS ANALYTICS

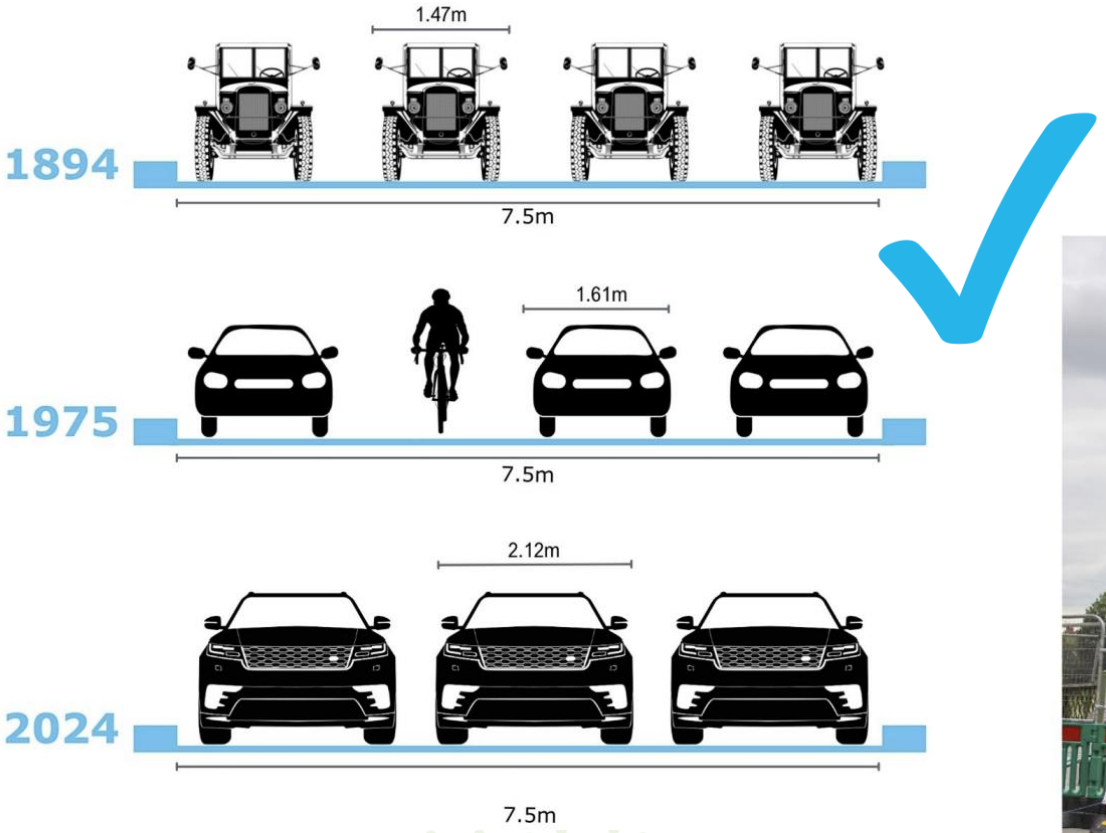
Testing the conjecture: noise

- Aerodynamics
- Engine
- Tyres



EMISSIONS ANALYTICS

Testing the conjecture: infrastructure



EMISSIONS ANALYTICS

Testing the conjecture: safety

- Good for you – bad for everyone else
  ➔ Externality

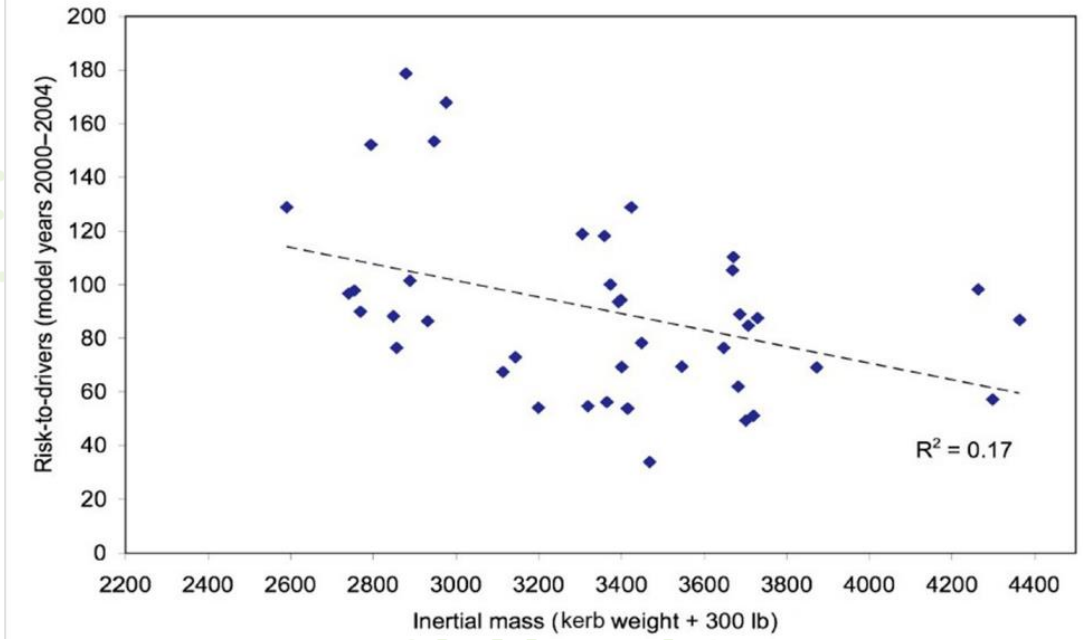
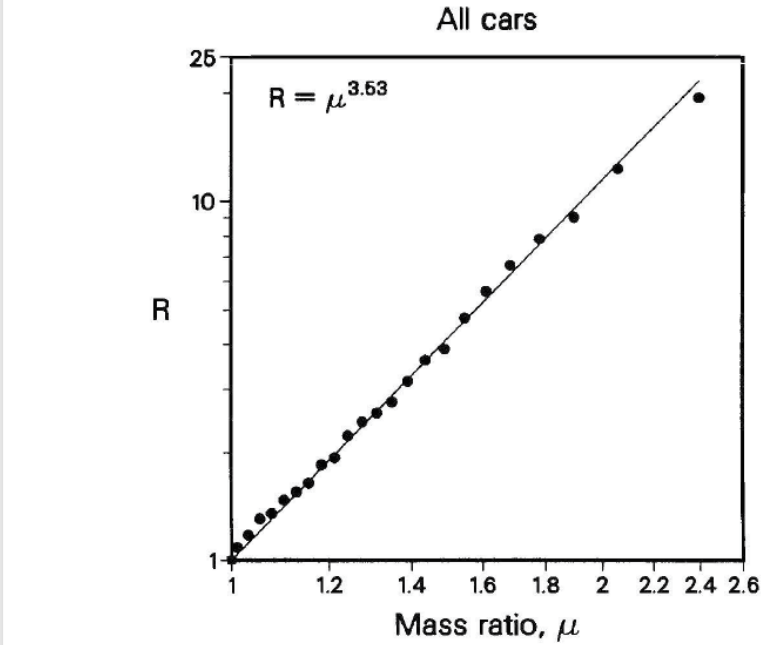


FIGURE 10.7 **(Continued)** Relationship between mass ratio of colliding vehicles and driver fatalities in a lighter vehicle from two different studies [10.20, 10.21].



EMISSIONS ANALYTICS

Making universal

- Works in any country in principle
- But does not treat ICEs and BEVs fairly
- So, needs adjustment to work for all car types
- Fossil fuel tax to compensate for hidden cost of carbon absorbed millions of years ago
- Avoids incentivising traditional ICEs when we must decarbonise
- Sets up incentive for renewable and e-fuels

➢Agnostic on changing powertrain or changing fuel

EMISSIONS ANALYTICS

UK tax before and after

- Revenue neutrality
- All cars subject to tax, because all cars have environmental effects
- Replace vehicle excise duty with this mass/weight tax
- ICE cars still pay fuel "fossil fuel duty

➢Aligned with environmental rather than redistribution goals

TABLE 12.2 Example taxations for popular vehicles in the UK market under this new mass–distance-based system and a representative current figure shown.

Vehicle	Weight (kg)	Mileage (indicative)	Tax under existing system	Tax under new system	Increase in tax
VW Up!	980	5000	£456	£490	£34
Mazda MX-5	1066	3000	£456	£320	-£136
Ford Puma	1358	4000	£866	£543	-£323
McLaren 720S	1419	2000	£2715	£284	-£2432
Renault Zoe	1502	5000	£0	£751	£751
Škoda Yeti	1565	9000	£737	£1409	£672
Nissan Qashqai	1670	8000	£1087	£1336	£249
Jaguar XF	1800	12,000	£1233	£2160	£928
Tesla Model Y	1930	10,000	£0	£1930	£1930
BYD Seal AWD	2185	6000	£0	£1311	£1311
Jeep Grand Cherokee	2503	10,000	£1112	£2503	£1391
Kia EV9	2660	8000	£0	£2128	£2128
Audi SQ8	2725	4000	£2826	£1090	-£1736

$$\text{Annual vehicle tax}\,(£) = \frac{m}{m_{av}} \times \frac{d}{d_{av}} \times \frac{T}{N}$$

EMISSIONS ANALYTICS

Robustness

- Weight is easy to measure
- And hard to cheat
- Both weight and distance are already legal measures
- Unlike tailpipe emissions
- And lifecycle

➢ Avoids another Dieselgate

#Dieselgate

Limitations

- Lightweighting
- Hydrogen
- Sports cars
- Jevons Paradox
- Vehicles that are not cars
- Doesn’t have to work for ever – wouldn’t have worked 10 years ago, and might not in 50 years’ time

Conclusions

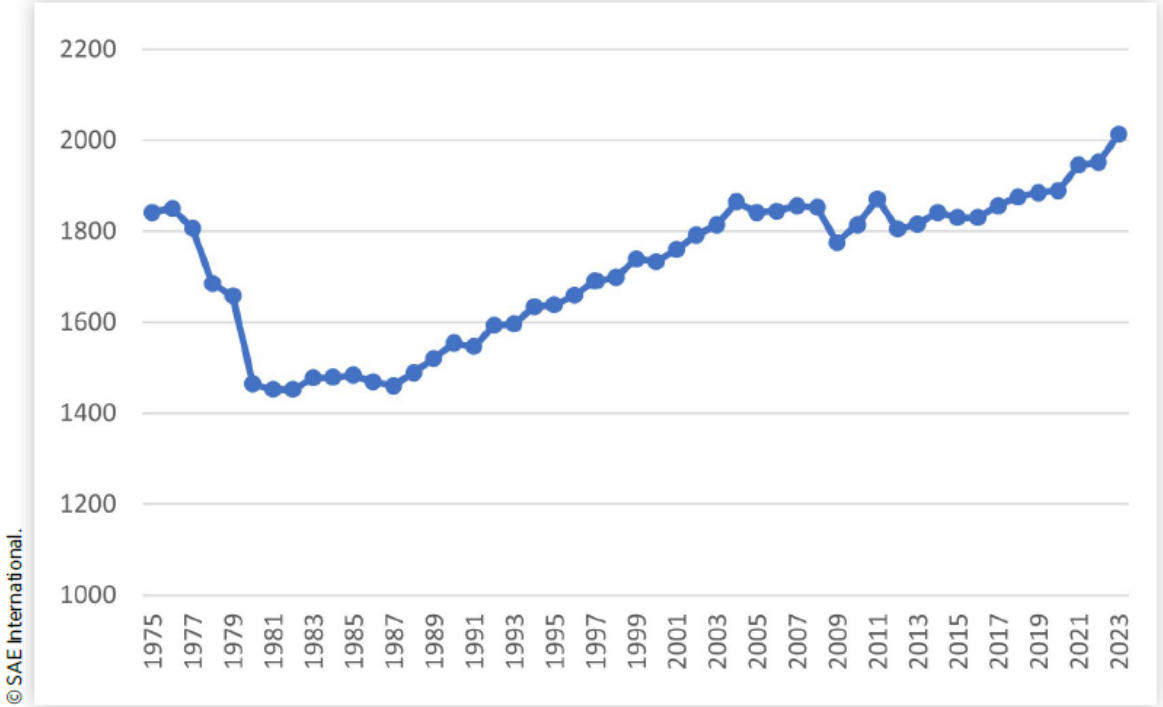
- Vehicle mass is the single best predictor for environmental impact
- In a multi-powertrain world, less complexity not more is better for consumers
- We need good-enough rather than unattainable perfection
- Our proposal makes tax predictable, unlike today's jumble of taxation, ratings and labelling

EMISSIONS ANALYTICS

Action vs inaction

- We could choose to do nothing, but at a price
- Lighter cars, robust tax base, reduced environmental impact
- OR Heavier cars, less tax, more environmental damage
- Car tax is controversial, but this is simple, fair and necessary

FIGURE 11.6 Average vehicle mass in the US market 1975–present (data, US EPA) [11.21].

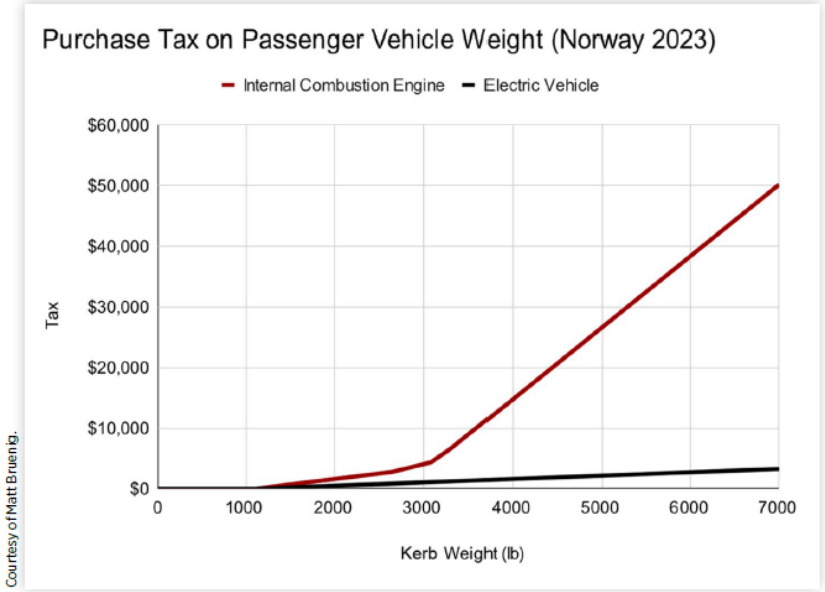


EMISSIONS ANALYTICS

Some progress…

- Norway: purchase tax
- Japan: kei cars + environment performance tax based partly on weight
- France: €10/kg above 1.8 tonnes; higher parking fees in Paris
- Netherlands: annual ownership tax
- Per-kilometre system introduced in Iceland for BEVs

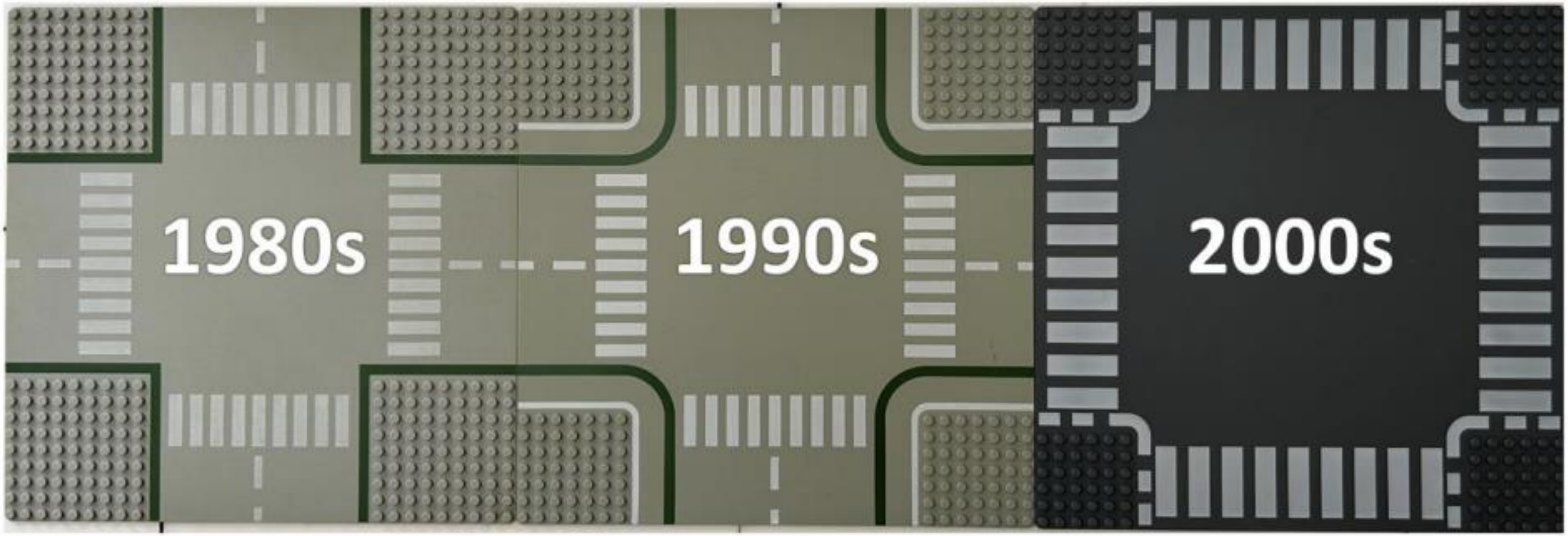
FIGURE 4.1 Norwegian weight tax proposal [4.35].



Courtesy of Matt Bruenig.

EMISSIONS ANALYTICS

Truth through Lego...

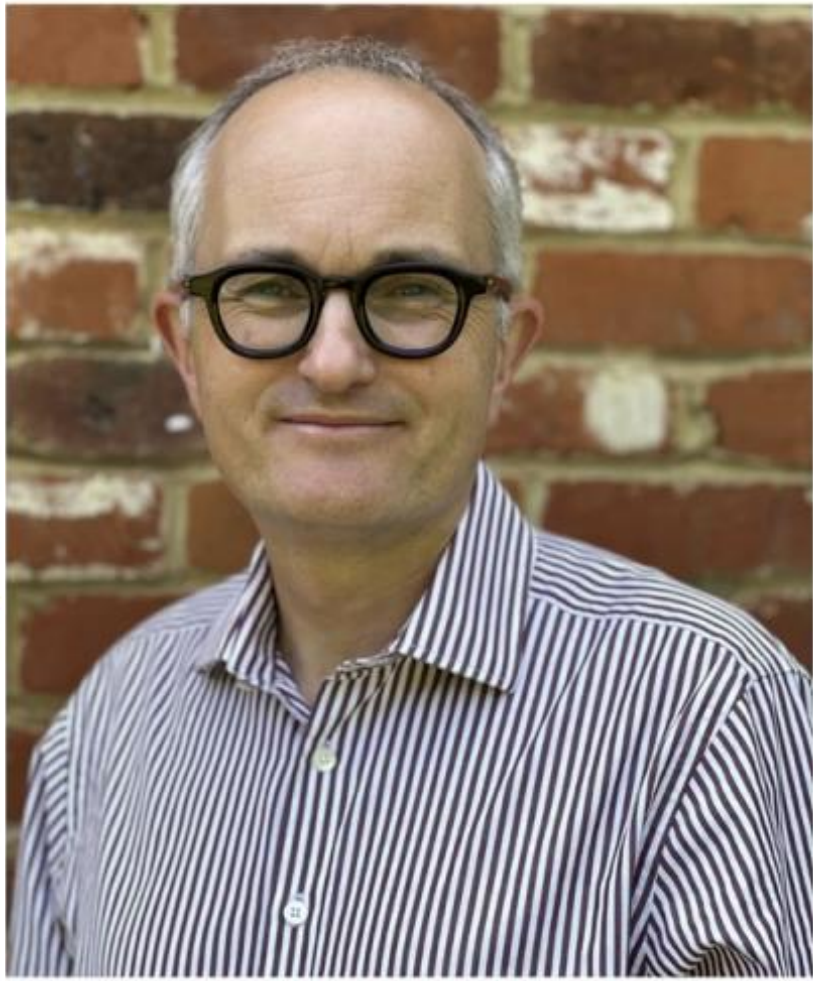


EMISSIONS ANALYTICS

Authors

Professor Felix Leach
University of Oxford

Nick Molden
Emissions Analytics



EMISSIONS ANALYTICS

Thank you

EMISSIONS ANALYTICS

DEPARTMENT OF ENGINEERING SCIENCE

UNIVERSITY OF OXFORD

EMISSIONS ANALYTICS

Thank you.

Nick Molden

Chief Executive Officer

nick@emissionsanalytics.com

+44 (0)20 7193 0489

ASSURED | INDEPENDENT | RESPONSIVE