



The air we breathe...

Urban transportation and air pollution

Steen Solvang Jensen
Senior researcher
Section of Atmospheric Modelling

Matthias Ketzel, Jørgen Brandt, Jesper Christensen, Camilla Geels,
Ole Hertel, Thomas Ellermann, Morten Winther, Marlene Schmidt
Plejdrup, Ole-Kenneth Nielsen, Mikael Skou Andersen



Complex urban transport challenges

Urbanisation
and
urban sprawl

Traffic
increase,
congestion,
time loss

Limited
road and
urban space

Inactive
transportation

Liveability
and mobility



Traffic
accidents

Impacts of
climate
change

GHG
emission

Air pollution,
health
impacts

Noise



My three questions

How does air pollution affect our health?

What sources contribute to air pollution?

What policy measures can reduce air pollution and Green House Gas emissions from road transport?

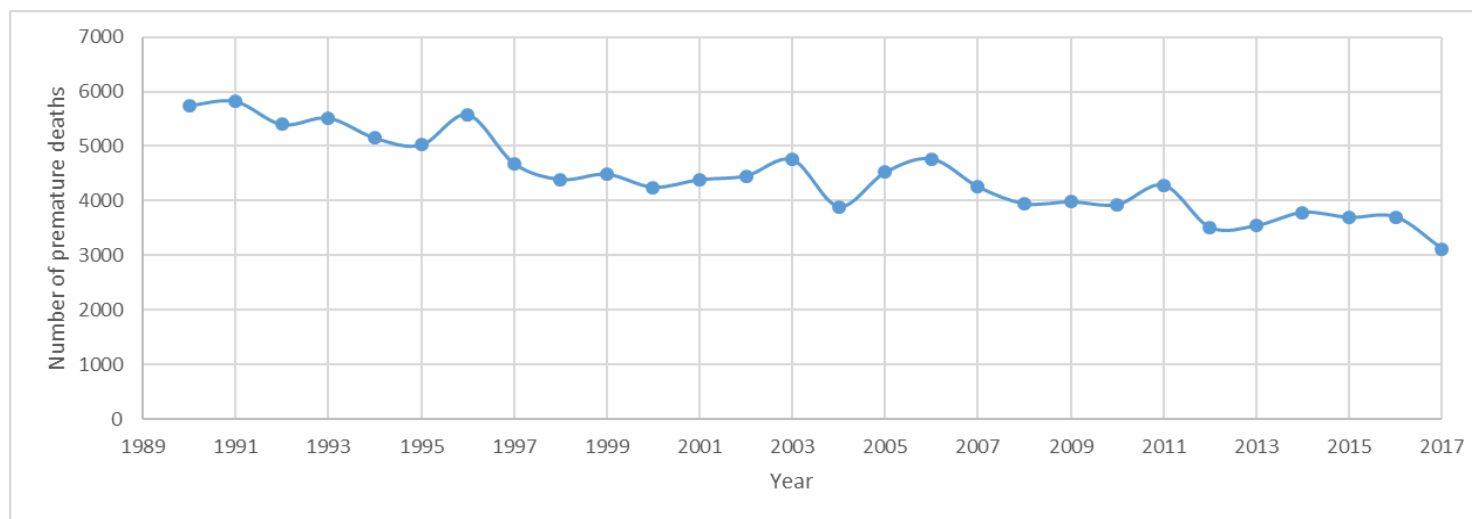
Trends in health impacts in DK

Approx. 3,000 premature deaths due to Danish and foreign emission sources in 2017

DKK 25 billion in social costs

Approx. 25% due to Danish sources, 75% to foreign

"export" = "import"





Sources of health impacts in Capital Region of Copenhagen

Premature deaths

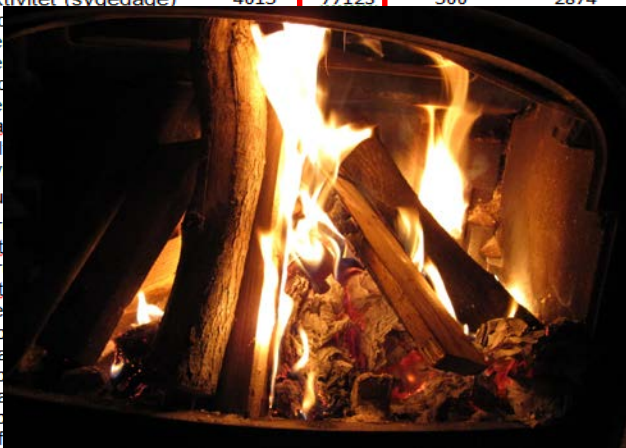
77 due to wood stoves and 23 due to road transport

Approx. 122 due to emission sources in Capital Region of Copenhagen

Approx. 1,150 due to all air pollution

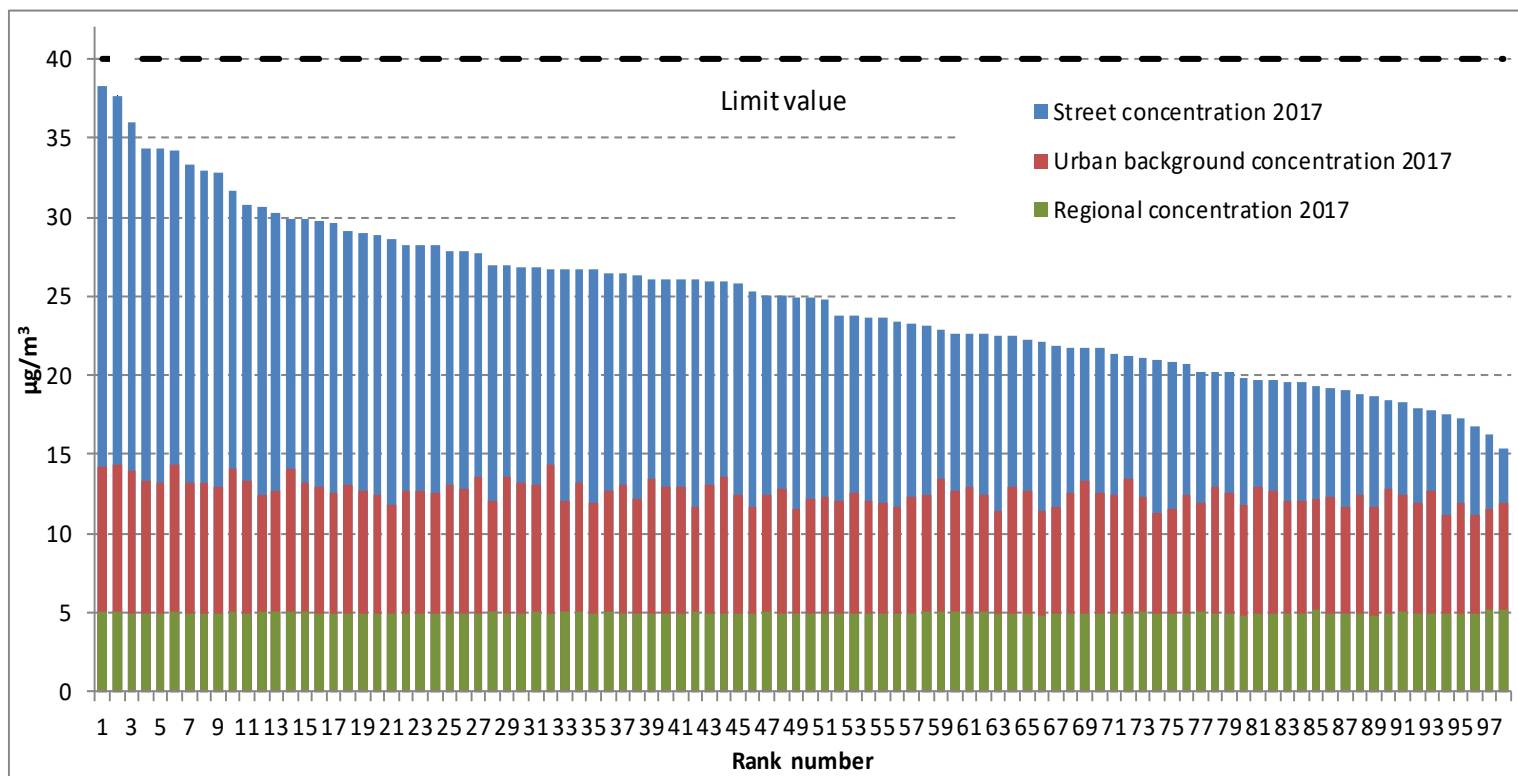
Tabel 7.2. Helbredseffekter i Region Hovedstaden pga. og fordelt på lokale emissionskilder i Region Hovedstaden efter SNAP-kode i 2014 (kun emissionskilder i Region Hovedstaden samt søfart op til 25 km fra regionen). Enhed: antal tilfælde.

	1 Kraft-Var-me mv.	2 Ikke-in-dusti-el. forbr. Mv.	3 Frem-Stil-ling mv.	4 Industriel-le pro-cesser	6 Anv. af produkt	7 Vej-trans-port	802 Jern-ba-ne	808 Ikke-vej-gå-ende mask	9 Af-falds-be-hand-ling	10 Land-brug	Int. sø-fart	Alle kilder i RH samlet
Kronisk bronkitis	4	75	1	3	5	31	1	4	7	1	2	133
Dage med nedsat aktivitet (svogedage)	4015	77123	500	2874	5495	31493	638	4545	6831	581	2305	136150
Hørselshed					0	2	0	0	0	0	0	7
Hørselshed ved svækket hørelse					1	4	0	1	1	0	0	17
Lungesygdom					0	5	0	0	1	0	0	16
Brug af antibiotika					13							20
Brug af antibiotika blandt børn					105							3539
Episoder med nedre luftvejssymptomer blandt voksne					46							26065
Episoder med nedre luftvejssymptomer blandt voksne (YOLL)					108							12229
Episoder med nedre luftvejssymptomer blandt børn					17							26831
Episoder med nedre luftvejssymptomer blandt voksne (YOLL)					17							4719
Akutte tabte leveår	-1	0	0	0	0	-7	0	-1	0	0	-1	-12
Kroniske tabte leveår (YOLL)	40	820	5	30	55	320	7	46	68	7	24	1417
For tidlige dødsfald	3	77	0	3	5	23	0	4	6	1	1	122
Dødsfald blandt spædbørn	0	0	0	0	0	0	0	0	0	0	0	0



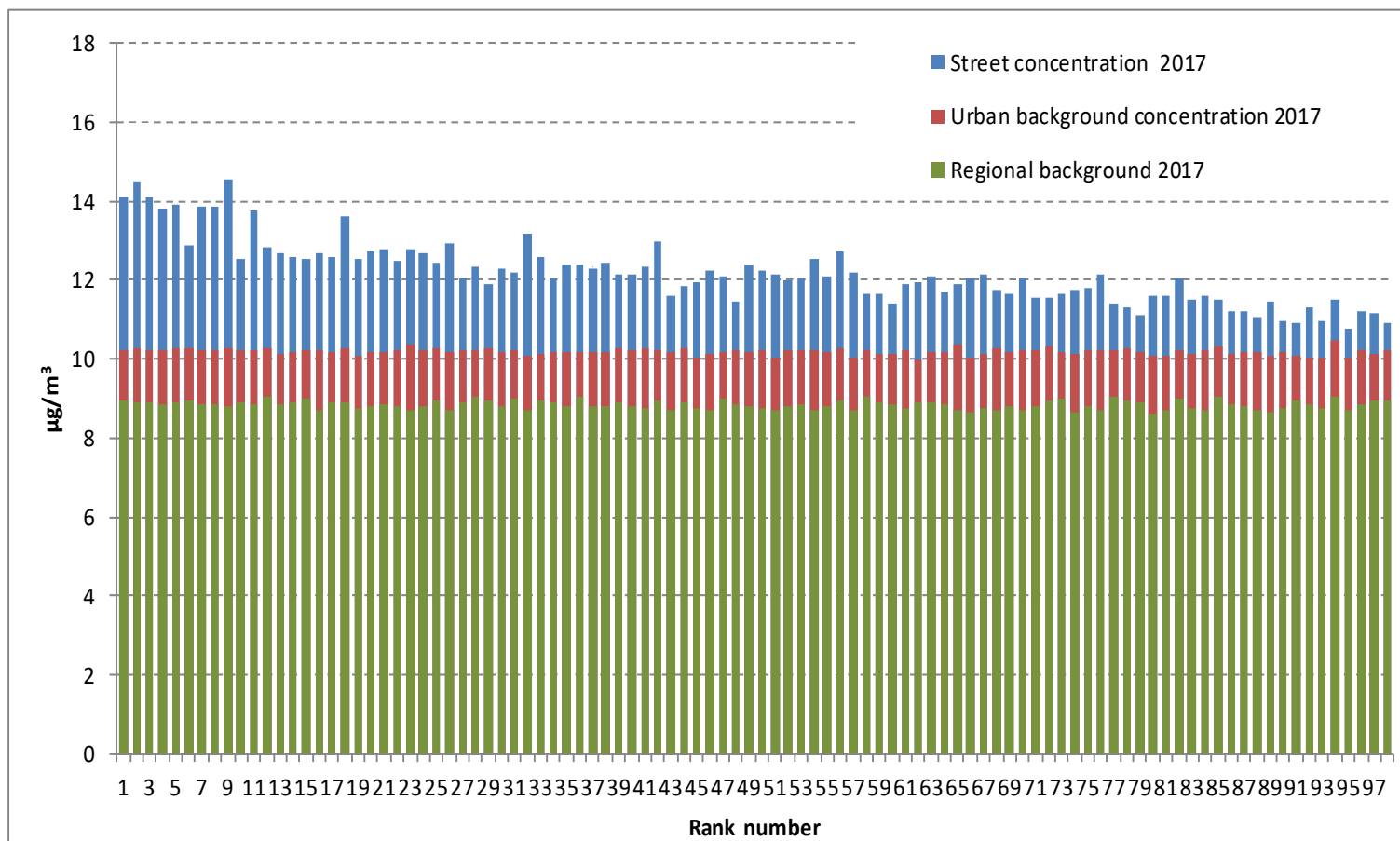


Contributions to NO₂ in CPH streets

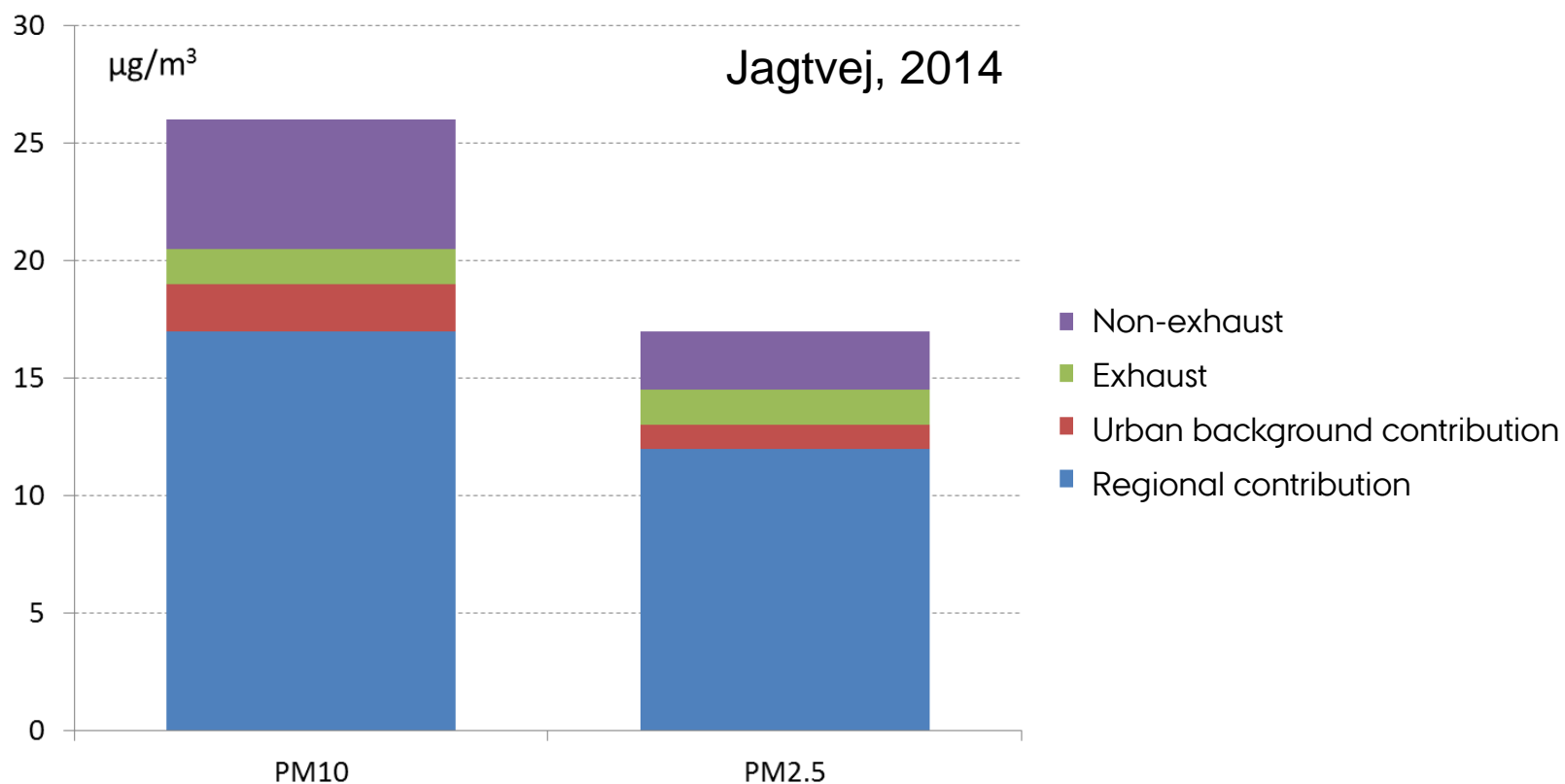




PM_{2.5} in CPH streets

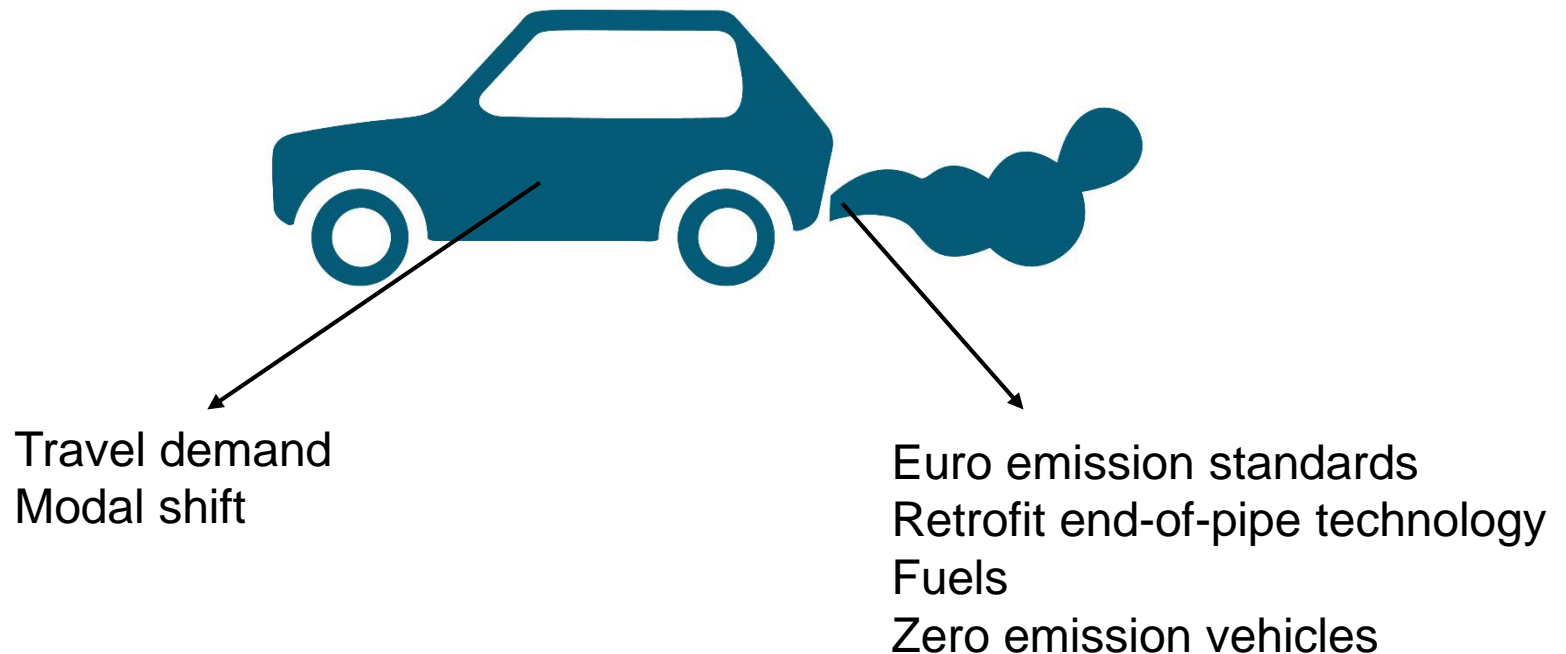


PM exhaust and non-exhaust



Managing traffic air pollution

$$\text{Pollution} = \text{Activity} \times \text{Emission}$$

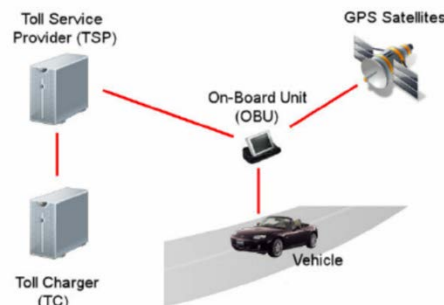
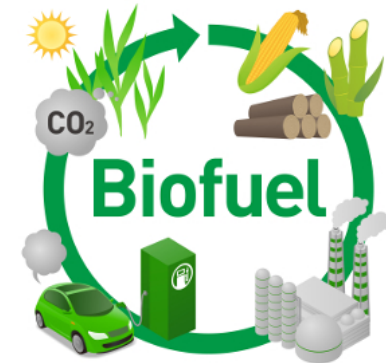


Different types of policy measures for road transport

Toolbox is very large and diverse

Examples within:

- Electrification
- Biofuels
- Low Emission Zone
- Toll ring and road pricing





Electrification of transport: implications

No exhaust emissions and related health impacts
- still non-exhaust

CO₂ neutral in 2030

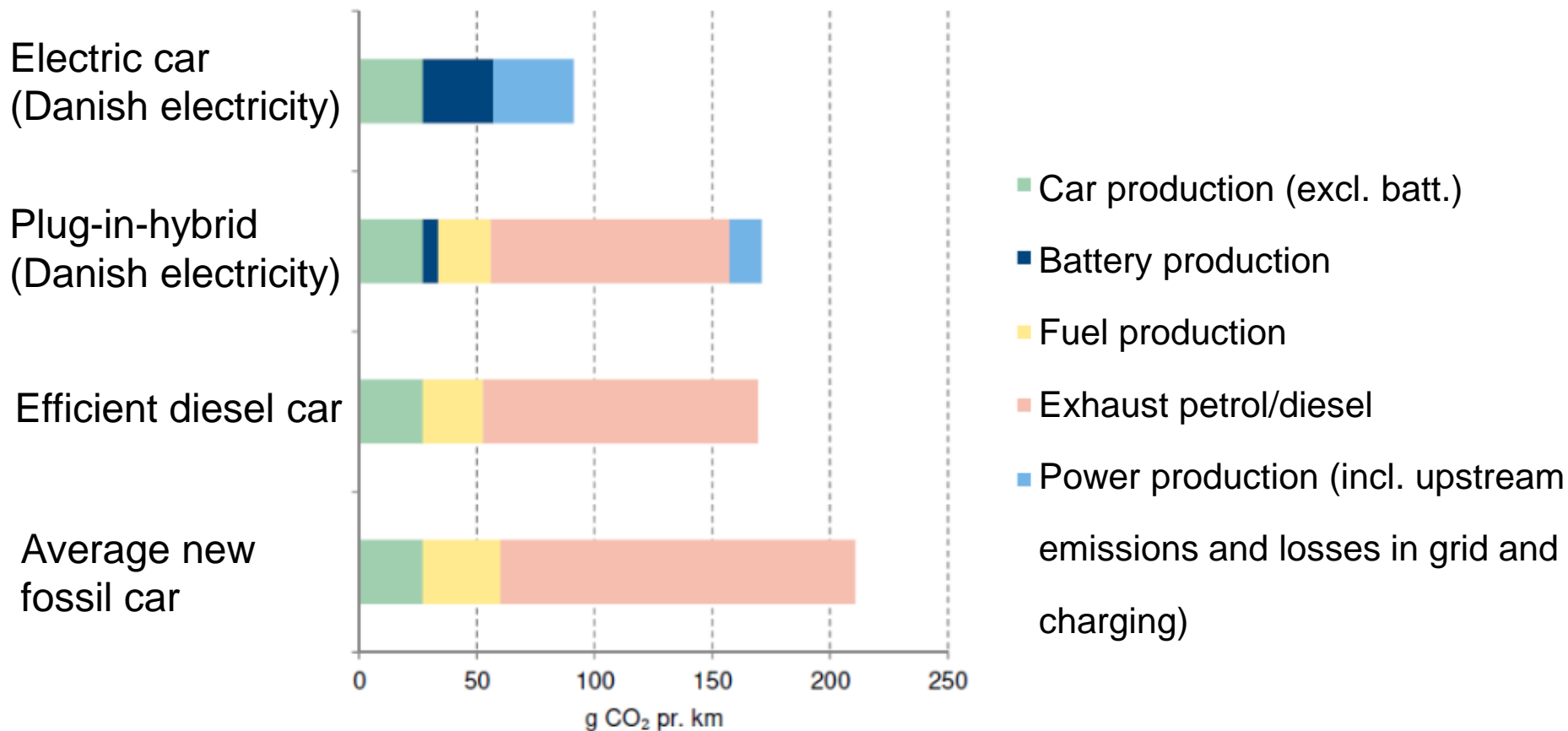
More models, longer driving range, faster charging

Norway number one due to strong incentives

1 million EV, plug-in hybrid and hybrid cars in Denmark in 2030?



LCA of electric cars for CO₂



Biofuels

For new vehicles: emissions determined by emission control technology

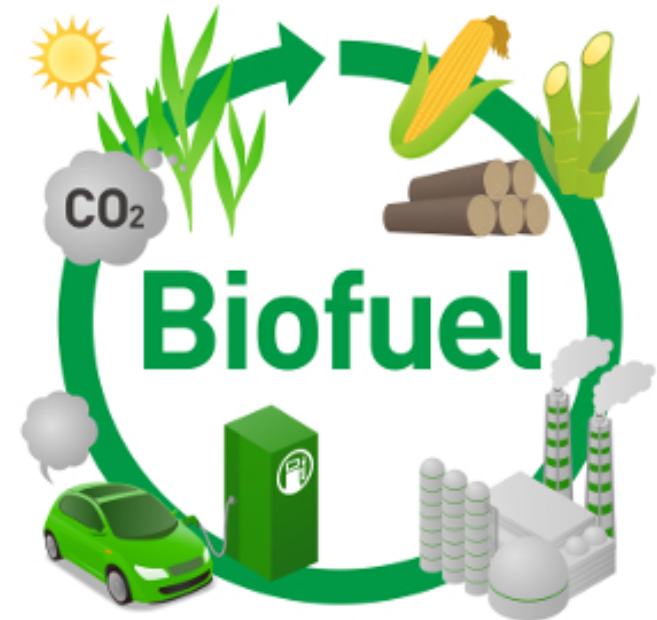
Gas and petrol/diesel engines – same Euro 6 standard

Some emission reduction for older Euro standards with no control technology

GHG benefit

- Large for biogas
- Less for bioethanol and biodiesel

Biogas particularly interesting for heavy-duty vehicles where electrification can be difficult



Low Emission Zones

No remaining effect of existing LEZ for heavy-duty vehicles

Government proposal:

- › Vans Euro 4 (2020), Euro 5 (2022), Euro 6 (2025)
- › Buses and truck Euro 5 (2020), Euro 6 (2022)
- › 25% reduction of PM exhaust and 10% of NO_x





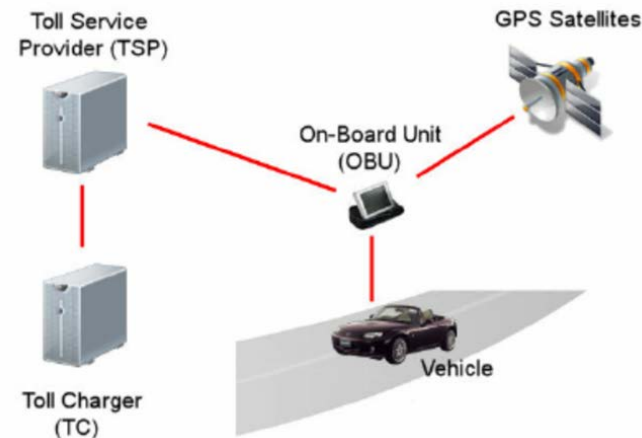
Toll ring and road pricing

Toll ring to reduce traffic in Copenhagen by 13-25%

Road pricing to reduce traffic by 7-13% nationally

Less relative reduction in exhaust

Technological measures more effective than traffic measures e.g. EVs reduce 100%





My three questions

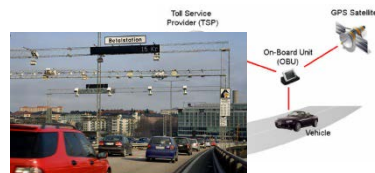
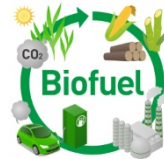
How does air pollution affect our health?



What sources contribute to air pollution?



What policy measures can reduce air pollution and Green House Gas emissions from road transport?



My points

Health: the air we breathe in our cities has high health impacts

Sources: road traffic is an important source to air pollution

Electrification: potential to solve air quality and GHG emission issues

Biofuels: few benefits for air quality but can help reduce GHG emissions especially for heavy-duty vehicles

Low Emission Zones: effective in limited geographic areas

Traffic measures: relatively little impact on emissions compared to technological measures