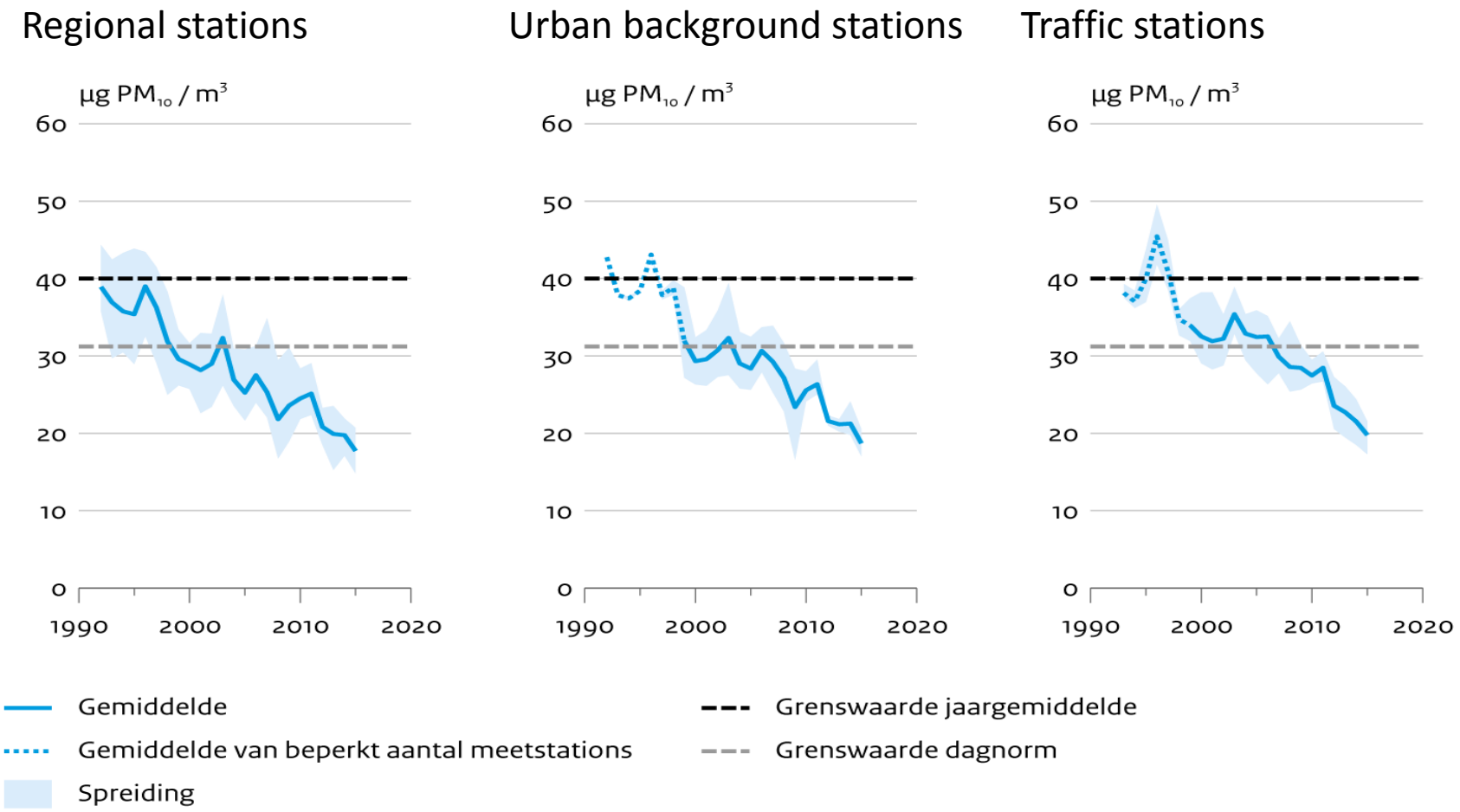
National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Towards a Clean Air Accord for the Netherlands

Joint action program of cities and the national government
aimed at reducing health risks,
continuous improvement of air quality,
beyond stand-still, beyond AQLVs
and in the long run even beyond WHO AQGs

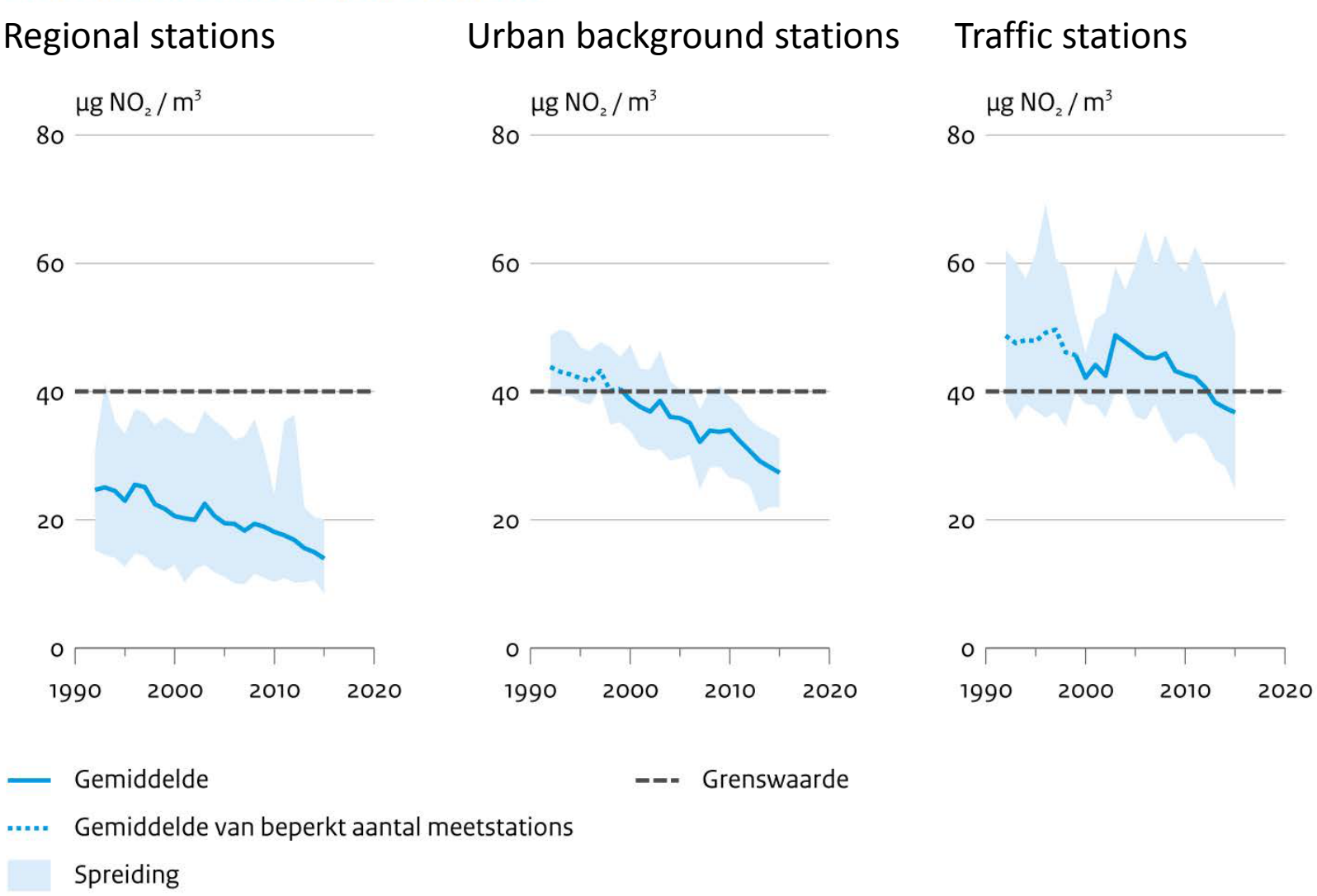
Rob Maas (RIVM)
24 April 2019

Downward trend in PM10 exposure



Source: RIVM

NO_2-exposure in busy streets is a persistent problem



Source: RIVM

What is the scope for national measures?

Share of sectors in the average exposure from national sources

	PM2.5 (primary + secondary)		NO_2	
	2012	**2016**	**2012**	**2016**
Industry	11%	13%	7%	9%
Transport	51%	38%	79%	75%
Agriculture	20%	29%	2%	7%
Residential heating incl. offices and shops	18%	20%	11%	9%
Transboundary contribution		**(60%)**		**(25%)**

Source: RIVM

World Health Organization
REGIONAL OFFICE FOR Europe

Health risks of air pollution in Europe – HRAPIE project

Int J Public Health (2015) 60:619–627
DOI 10.1007/s00038-015-0690-y

ORIGINAL ARTICLE

Quantifying the health impacts of ambient air pollutants: recommendations of a WHO/Europe project

Marie-Eve Héroux · H. Ross Anderson · Richard Atkinson · Bert Brunekreef · Aaron Cohen · Francesco Forastiere · Fintan Hurley · Klea Katsouyanni · Daniel Krewski · Michal Krzyzanowski · Nino Künzli · Inga Mills · Xavier Querol · Bart Ostro · Heather Walton

Received: 1 December 2014 / Revised: 7 May 2015 / Accepted: 11 May 2015 / Published online: 30 May 2015

ehp ENVIRONMENTAL HEALTH PERSPECTIVES
http://www.ehponline.org

Air Pollution and Mortality in Seven Million Adults: The Dutch Environmental Longitudinal Study (DUELS)

Paul H. Fischer, Marten Marra, Caroline B. Ameling, Gerard Hoek, Rob Beelen, Kees de Hoogh, Oscar Breugelmans, Hanneke Kruize, Nicole A.H. Janssen, and Danny Houthuijs

http://dx.doi.org/10.1289/ehp.1408254

Received: 10 February 2014
Accepted: 6 March 2015
Advance Publication: 11 March 2015

REVIEW ARTICLE

Long-term Concentrations of Nitrogen Dioxide and Mortality

A Meta-analysis of Cohort Studies

Richard. W. Atkinson,[a] Barbara. K. Butland,[a] H. Ross. Anderson,[a,b] and Robert. L. Maynard[c]

HRAPIE-based tool

Utrecht 2015 (343.000 inhabitants)

Concentration PM10 in µg/m³) - population weighted average		15,80
Concentration PM2.5 in µg/m³ "		12,40
Concentration NO_2 in µg/m³ "		25,20
Morbidity	**Cases / Burden of Disease**	**Share in disease burden**
Due to PM10:		
Annual number of days with bronchitis in children (age 6-12 years)	2371	8,0%
Incidence chronic bronchitis in adults (age 18+ years)	120	11,3%
Incidence of asthma symptoms in asthmatic children (age 5-19 years)	5315	2,9%
Due to PM2.5:		
Hospitalizations, cardiovascular diseases	52	0,9%
Hospitalizations, respiratory diseases	50	1,8%
Restricted activity days (RADs) (including sick-leave, hospital admission, symptom days)	289803	4,4%
Work days lost, working age population (age 20-65 years)	90440	4,4%
Lung cancer (age 30+ years)	14	8,2%
Low birth weight (< 2500 g at term)	33	15,8%
		Total YLD: 152
Mortality		
Cases of post-neonatal mortality (age 1-12 months) due to PM10	0,1	4,1%
Cases of premature deaths due to PM2.5 (RR = 1,06; Co = 2.5)	106	5,8%
Cases of premature deaths due to NO_2 (RR = 1,02; Co = 5)	72	3,9%
		Total YLL: 1840
Decline in average life expectancy in days		
Due to PM2,5	208	(6.9 months)
Due to NO_2	139	(4.5 months)

Total burden of disease

DALY = YLL + YLD

YLD = Incidence x Disability weight x Length of period until death

Health impacts	Unit	Disabilty Weight per unit	Monetary damage per unit
Days with bronchitis in children (age 6-12 years)	Days/year	0.00062	€ 49
Incidence of asthma symptoms in asthmatic children (age 5-19 years)	Days/year	0.00019	€ 49
Incidence chronic bronchitis in adults (age 18+ years)	Number/year	0.99	€ 62712
Hospitalizations, cardiovascular diseases, all ages	Number/year	0.02255	€ 2574
Hospitalizations, respiratory diseases, all ages	Number/year	0.01565	€ 2574
Restricted activity days (RADs)	Days/year	0.00027	€ 108
Work days lost, population 20-65 years	Days/year	0.00027	€ 152
Years of Life Lost (YLL)	Number/year	1	€ 67500

What is the scope for local measures?

UTRECHT 2015	Burden of disease	Contribution local sources	Local contribution burden of disease
PM2.5 (+ condensables)	44,0%	12%	5%
NO_2	24,3%	50%	12%
EC	5,0%	50%	3%
Ozone	0,5%	0%	0%
Traffic safety	7,8%	80%	6%
Noise	5,4%	50%	3%
UV	4,7%	0%	0%
Indoor air	8,2%	100%	8%
Total	100,0%		37%

(same RR as PM2.5)

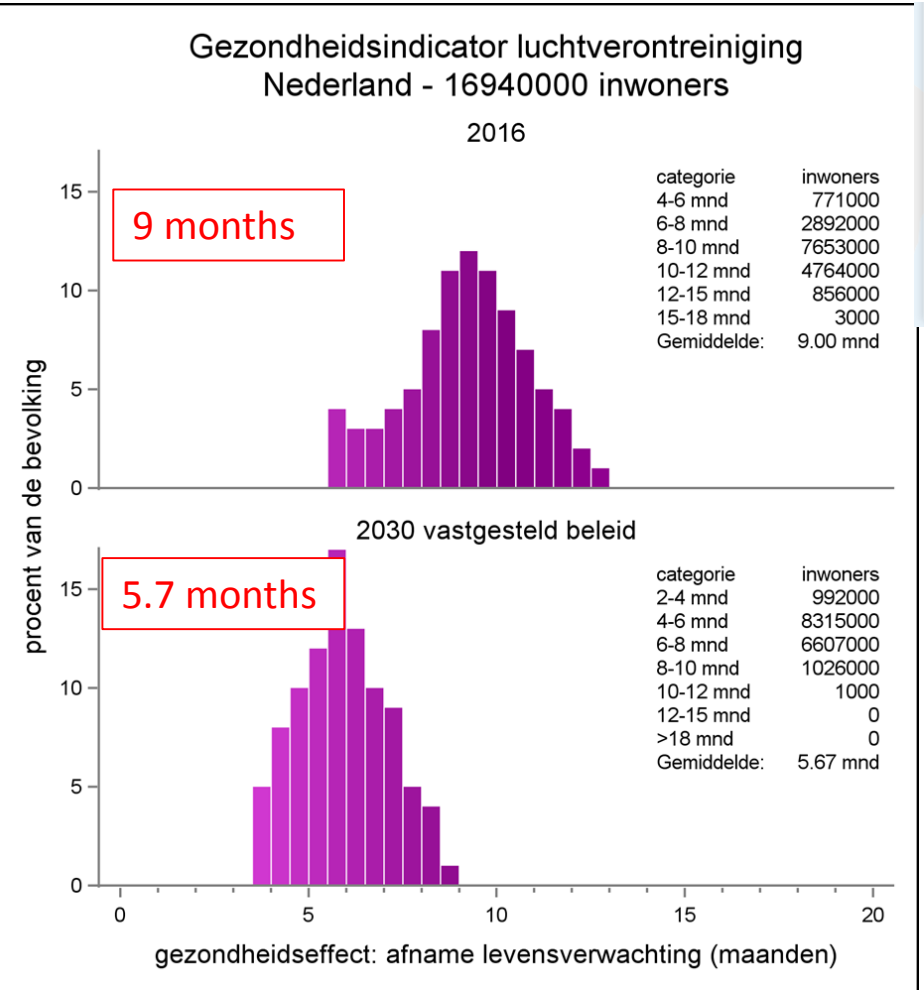
Health impact assessment of local policy measures - Utrecht

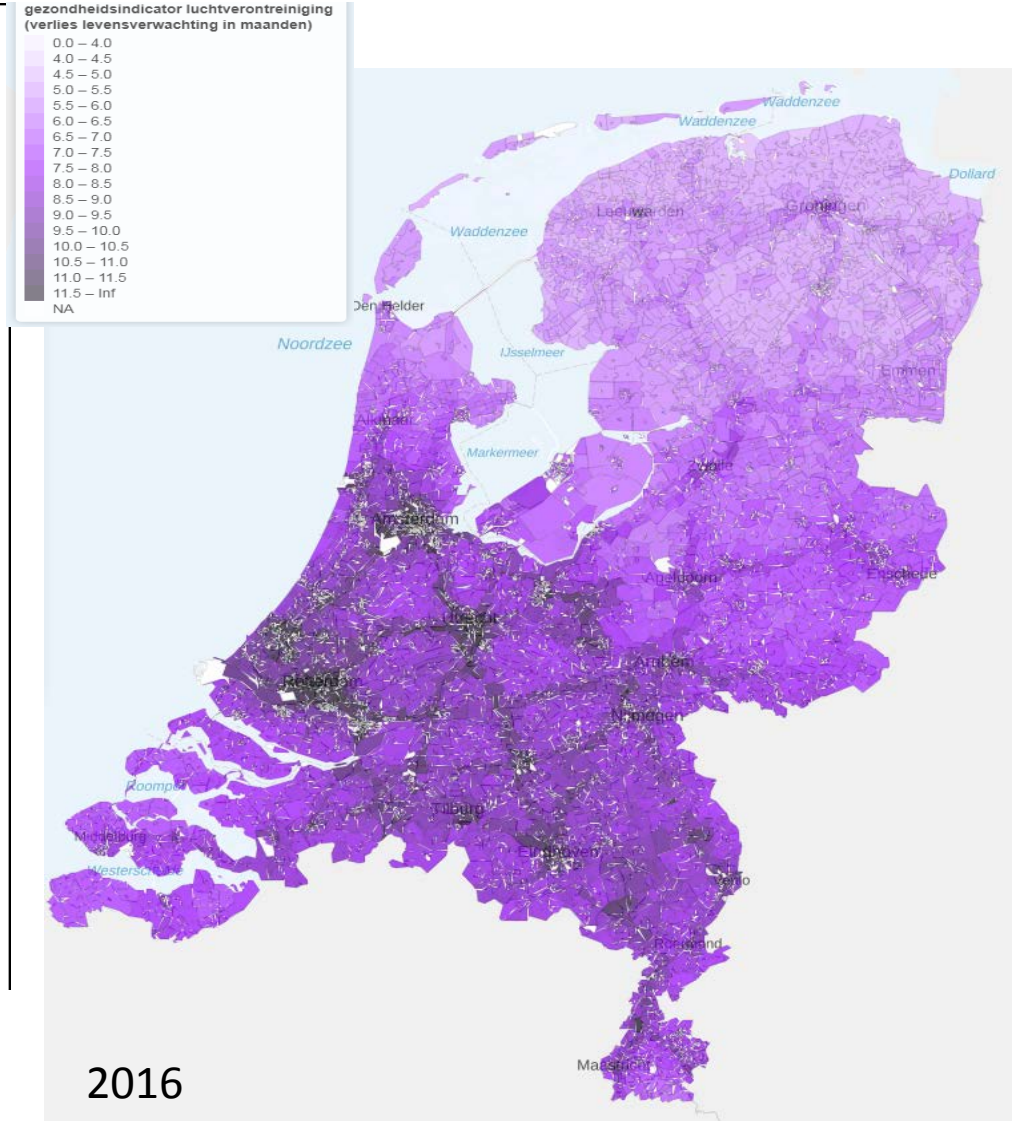
	Utrecht 2015	100% EV	LEZ	Inner city	100% EV	LEZ
µg/m³						
NO_2	25,2	12,6	22,7	28,8	21,6	27,4
PM10	15,8	14,9	15,3	20,8	20,2	20,2
PM2.5	12,4	11,7	12,0	13,0	12,6	12,6
Cases of attributable deaths						
PM2.5	106	-7	-4	6	-0	-0
NO_2	72	-44	-9	4	-1	-0
Average loss in life expectancy (days)						
PM2.5	208	-15	-8	221	-8	-8
NO_2	139	-87	-17	164	-50	-10
Days with bronchitis (children)	2371	-190	-105	408	-15	-15

- Local measures give more NO_2 benefits than PM2.5 benefits
- 100% electric cars gives more health benefits than banning old diesel vehicles in a LEZ
- Banning all cars is most effective
- A larger LEZ is more effective

Health impact assessment Netherlands

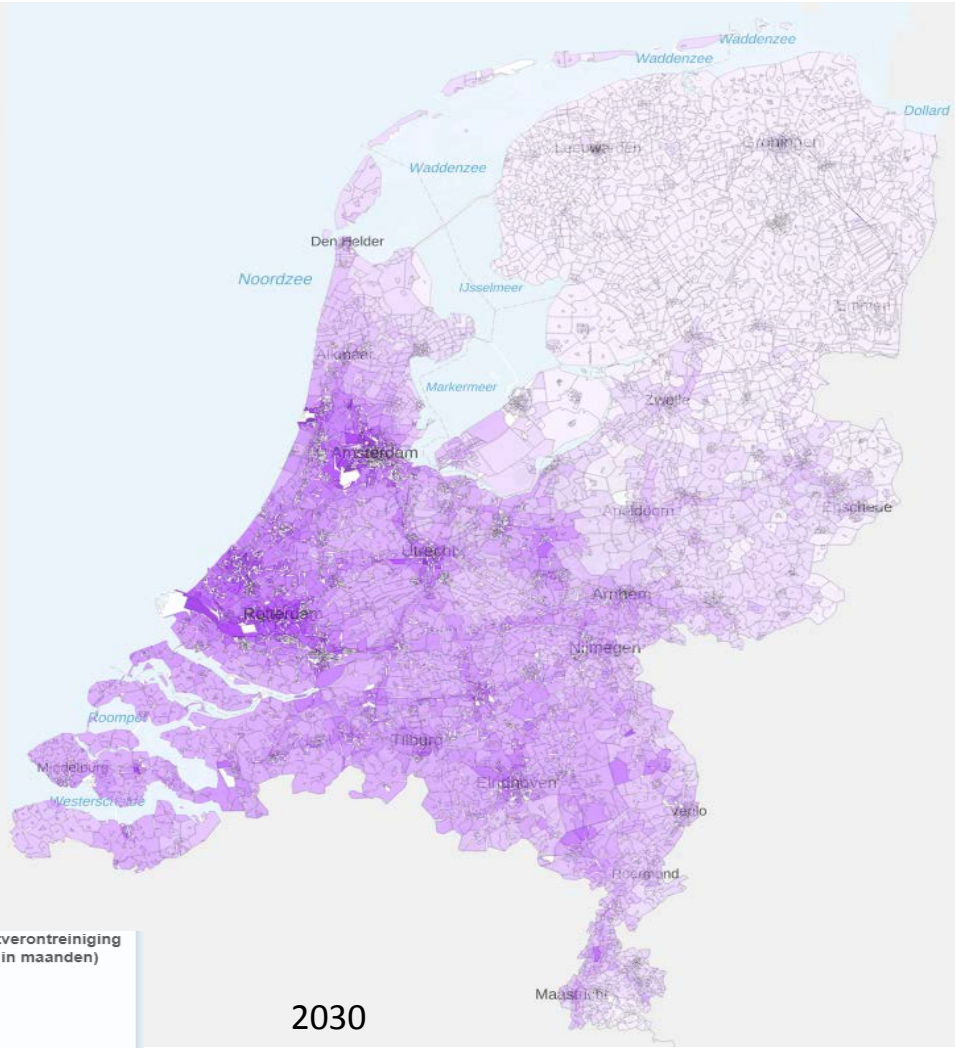
Loss of life expectancy in months - PM2.5 and NO_2 together)





~ 50% less health damage with full implementation of current policy

2016



2030

gezondheidsindicator luchtverontreiniging (verlies levensverwachting in maanden)

- 0.0 – 4.0
- 4.0 – 4.5
- 4.5 – 5.0
- 5.0 – 5.5
- 5.5 – 6.0
- 6.0 – 6.5
- 6.5 – 7.0
- 7.0 – 7.5
- 7.5 – 8.0
- 8.0 – 8.5
- 8.5 – 9.0
- 9.0 – 9.5
- 9.5 – 10.0
- 10.0 – 10.5
- 10.5 – 11.0
- 11.0 – 11.5
- 11.5 – Inf
- NA

Health impact assessment Netherlands

NETHERLANDS			
Average population exposure	**2016**	**2030 CLE**	**2030 ADD**
Concentration **PM2.5** in µg/m³	12,1	8,7	8,1
Concentration **NO2** in µg/m³	20,3	11,3	11,0
MORTALITY		**GAIN**	**GAIN**
Premature deaths			
Due to PM2.5	7800	-2700	-400
Due to NO2	4100	-2400	-100
Loss in life expectancy (months)			
Due to PM2.5	5,9	-2,1	-0,3
Due to NO2	3,1	-1,8	-0,1
Total years of life lost (YLL)			
Due to PM2.5	90.000	-30.000	-5300
Due to NO2	48.000	-27.000	-700
MORBIDITY			
Years of life with diseases (YLD)	**7000**	**-1900**	**-150**
Days with bronchitis in children	160.000	-40.000	-3000
Incidence chronic bronchitis in adults	5400	-1300	-100
Incidence of asthma symptoms in children	350.000	-90.000	-7500
Hospitalizations, cardiovascular diseases	2400	-850	-50
Hospitalizations, respiratory diseases	2500	-850	-50
Restricted activity days	13.800.000	-4.500.000	-40.000
Work days lost	4.350.000	-1.500.000	-10.000
Lung cancer	650	-200	-15
Low birth weight	1600	-500	-25
Total DALY (= YLD + YLL)	145.000	-60.000	-6000
Monetized health damage (mln €)	9500	-4000	-400

Top 1%	PM2.5	NO2
2016	14,6	29,2
2030CLE:	11,1	15,3
2030ADD:	10,3	15,0

Health impact assessment of potential national measures

	change in µg pm2,5	µg NO2	extra life expectancy (month)	avoided premature deaths	avoided DALYs	health benefits (mn €)	abatement costs (mn €)	benefit - costs (mn €)	costs/DALY
Ban on old wood stoves	0,162	0,005	0,10	131	2842	420	23	397	8093
Ban on using wet wood	0,304	-0,021	0,20	238	5160	768	82	686	15891
Zero emission cars	0,023	0,166	0,03	63	1354	188	0	188	0
100 km speed limit	0,012	0,103	0,03	38	800	151	85	66	106250
Slow steaming sea vessels	0,004	0,022	0,00	9	196	27	3	24	15306
Retrofit inland ships	0,011	0,067	0,00	27	576	80	11	70	18403
Low emission manure application	0,017	0	0,00	14	296	44	0	44	0
Low emission stables	0,015	0	0,00	11	260	39	8	31	30769
Feed adaptation	0,017	0	0,00	14	296	44	0	44	0
TOTAL	**0,565**	**0,342**	**0,358**	**545**	**11780**	**1762**	**212**	**1550**	**17963**

PM2.5 impacts include secondary particles

First reaction: these measures are not ambitious enough!
Also assess structural changes in energy use, (healthy) mobility and healthy diets

Cobenefits of climate policy

Reductions in µg/m3

		PM2,5 L	PM2,5 H	NO2 L	NO2 H
Energy	Energy saving buildings	0,002	0,009	0,027	0,125
	More biomass burning	-0,003	0,000	-0,012	0,000
	Shut down coal fired power plants	0,016	0,016	0,044	0,008
	TOTAL	0,015	0,025	0,059	0,133
Industry	Reduction fossil energy use in Industry	0,005	-0,025	0,036	0,059
	Energy saving steel production	0,000	0,005	0,000	0,021
	TOTAL	0,005	-0,020	0,036	0,080
Agriculture	Energy saving agriculture (greenhouses)	0,002	0,004	0,018	0,040
	Reduction cattle stock / meat consumption	*0,031*	*0,062*	*0,000*	*0,000*
	Replacement of chemical fertilizers by organic fertilizer	*0,006*	*0,013*	*0,000*	*0,000*
	TOTAL	0,039	0,079	0,018	0,040
Traffic	Road pricing	0,011	0,011	0,078	0,078
	Reduction maximum speed (130 →120 km/h)	0,002	0,002	0,009	0,009
	Zero emission distribution of goods in cities	*0,005*	*0,010*	*0,037*	*0,073*
	30% reduction of freight transport on roads	*0,003*	*0,005*	*0,045*	*0,090*
	8% less private car use (more walking, cycling, public t.)	*0,003*	*0,006*	*0,022*	*0,044*
	Zero emission cars	0,015	0,022	0,111	0,156
	TOTAL	0,039	0,056	0,302	0,450
Total		**0,098**	**0,140**	**0,415**	**0,703**

Climate policy gives more NO_2-benefits than PM2.5 benefits !

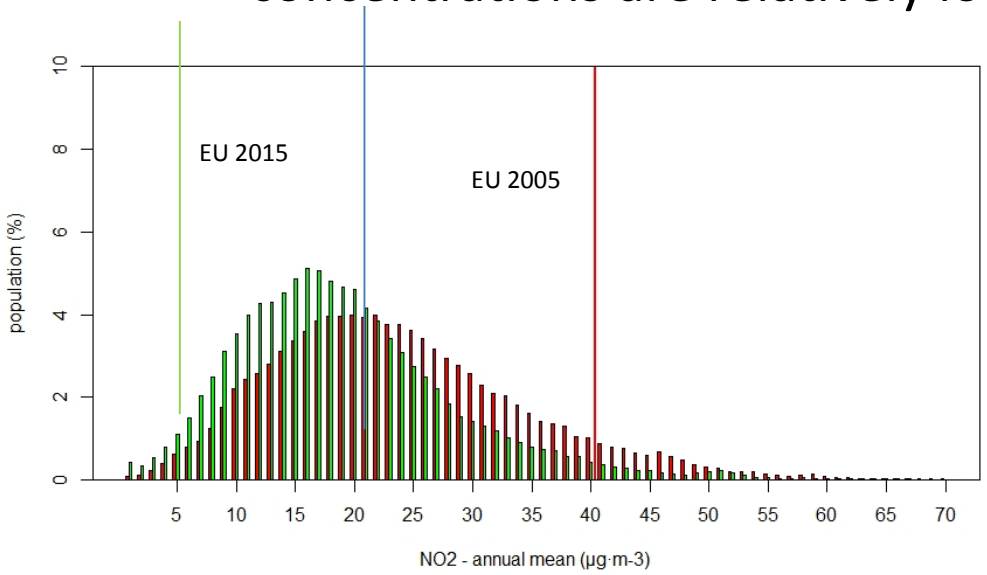
Health benefits of cleaner air

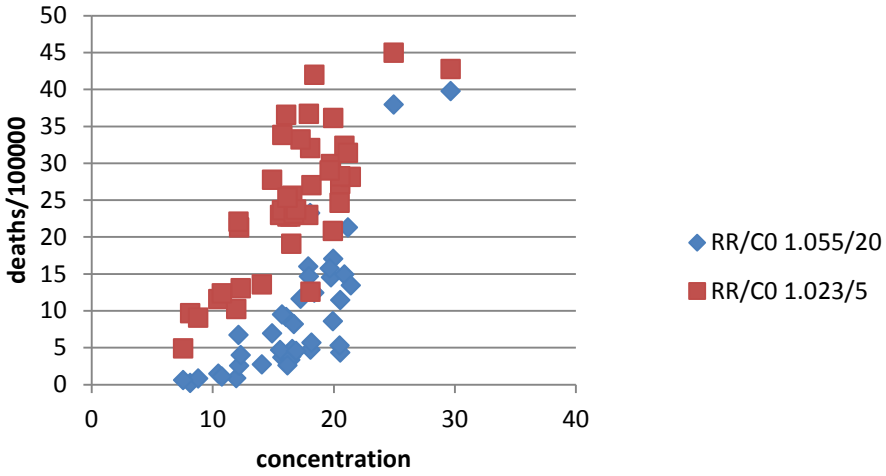
	PM2.5	NO_2	PM2.5+NO_2
CLE: Extension of average life expectancy between 2016 – 2030 (months)	1,6	1,7	3,3
CLE: Reduction in attributable deaths (cases)	2200	2500	4700
CLE: Life years gained (years)	23800	26900	50700
CLE: health improvement 2016-2030 (in %)	**17%**	**19%**	**37%**
ADD: Additional extension of life expectancy in 2030 (months)	0,2-0,5	0,2-0,5	0,4-0,8
ADD: Additional reduction in attributable deaths (cases)	225-625	215-365	440-990
ADD: Additional life years gained (years)	2400-6600	2300-3900	4700-10500
ADD: total health improvement 2016-2030 (in %)	**19-22%**	**21-22%**	**40%-44%**

Aiming at 50% health improvement requires cooperation with surrounding countries

Discussion

- How likely is full implementation of current legislation?
- How to include condensables?
- Potential overlap of PM2.5 and NO_2 health impacts considered to be small, due to low RR for NO_2. But what to do with measures that change the PM2.5/NO_2- mixture significantly?
- How to include health benefits below WHO-AQGs? A lower Co will lead to a higher effectiveness of policy measures when concentrations are relatively low





Based on EEA-data analysis