



Rijksinstituut voor Volksgezondheid
en Milieu
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Ultra Fine Particles

What's up?

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Ultra Fine Particles

- > Extreme small particles, size $< 0.1 \mu\text{m}$
- > Different sizes, and different composition of the particles
- > Sometimes UFPs have a short lifetime, coagulate together, or react with other particles
- > Possible that amount of UFPs from an exhaust can reduce soon
- > Very light, so cannot be expressed in grams \gg number of particles per cm^3 is a better metric
- > Relatively little knowledge about it (compared to particle mass)
- > But UFP causes health damage: penetrate deep into the lungs
- > Complex relation to 'regular' PM10, PM2.5, ...



Ultra Fine Particles: actions and research

- > EU develops **Air Quality Directive** with measuring as objective
 - UFPs “*one of the unregulated air pollutants of emerging concern*”
- > Dutch Health council advises: start UFP measuring and modelling
 - Goal: determine the amount of UFPs inhaled by Dutch population
 - Government asks RIVM: set up UFP measurement infrastructure
 - Collaboration with TNO

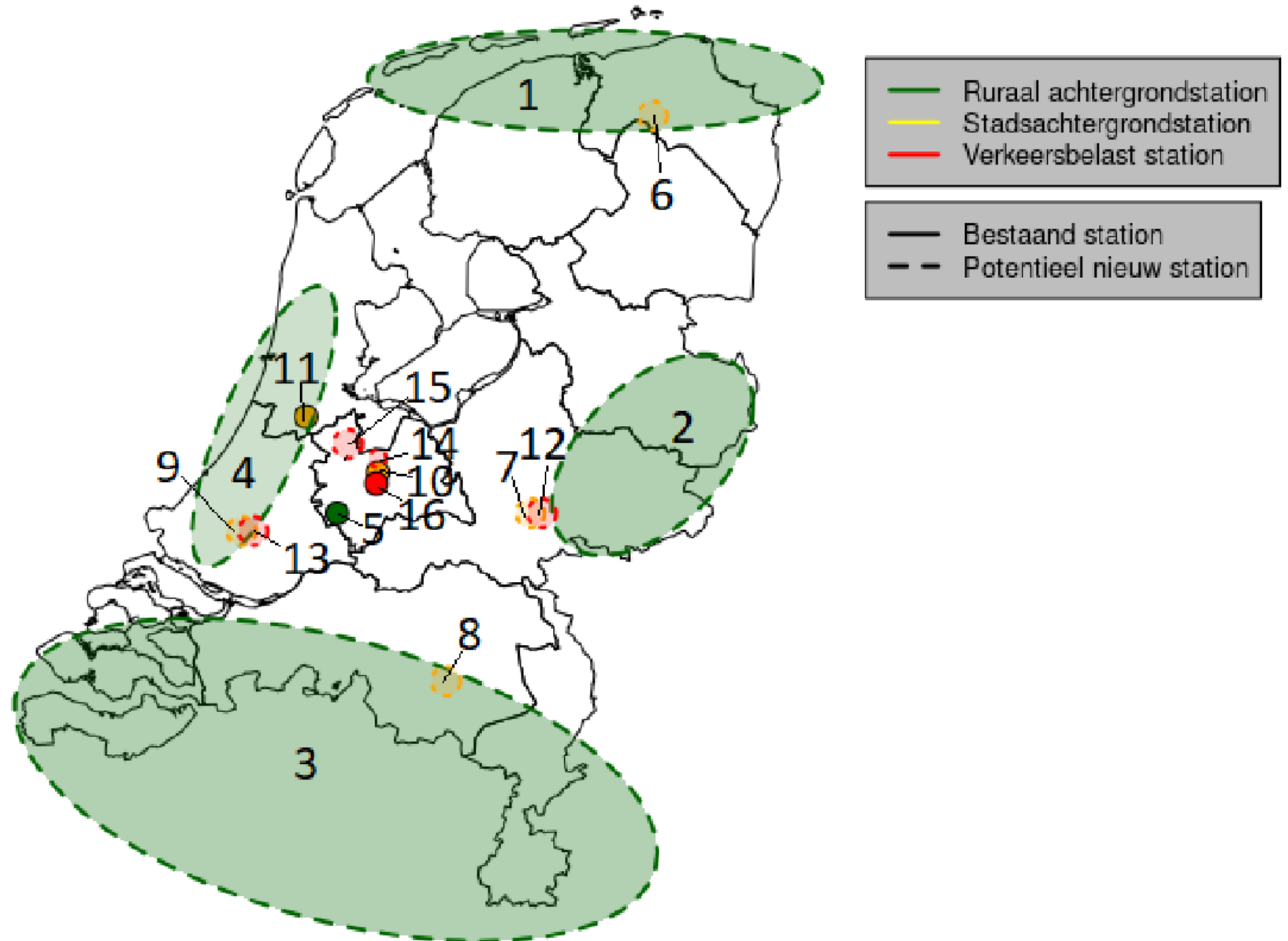


Measuring issues

- > EU proposal: UFP measuring at 'super sites'. Recently measuring stations installed in Belgium, and since 2008 in UK (London)
- > RIVM exploits the *National Air Quality Monitoring Network*, but UFPs cannot be measured in grams, particles should be counted
- > RIVM proposal: combination of at least 7 fixed monitoring stations to count the number of particles, and a few mobile stations to measure their number and size, and also the provenance of the emissions
- > Measurements supplemented with calculations derived from computer modelling, to get clear picture of population exposure
- > Discussions held with Belgian and UK experts, as well as regional monitoring experts and Dutch health experts



General sketch



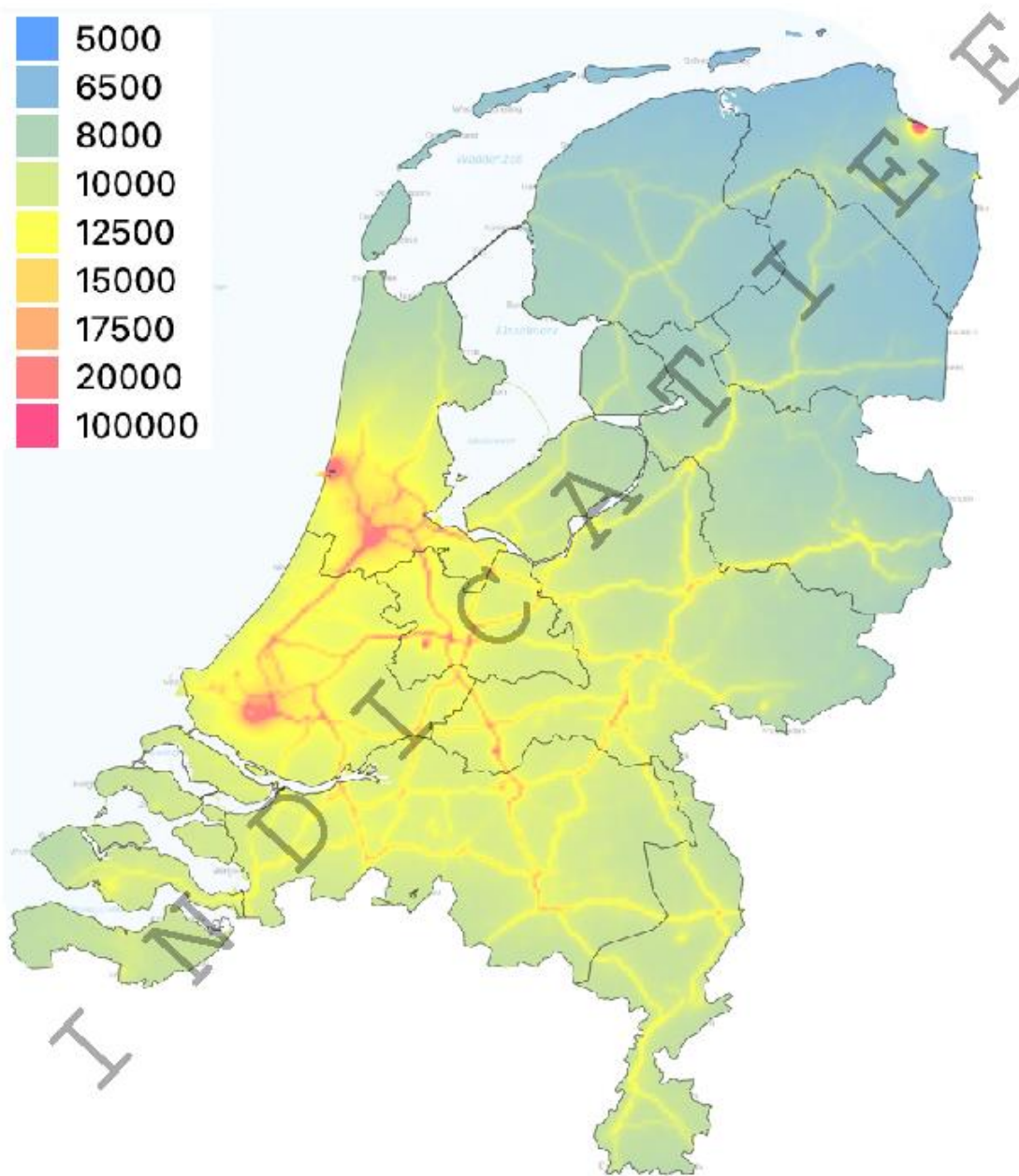


Identifying health risks: expert advices

- > To establish human exposure, UFP measurement data from places where people reside is required. Measurements near specific UFP sources are not a priority.
- > Establishing a relationship between UFP exposure and related health effects requires a nationwide UFP map on an annual basis. A spatial resolution below 1x1 km² is also required.
- > Instrumentation must be able to register at least particles with a size of 10 nanometers (0.01 μm).
- > Understanding long-term trends in UFP levels is important for health impact assessment.



Preliminary studies: indicative map





TNO research project: estimating emissions

- > Initial raw estimate on Dutch UFP emissions: based on ongoing RI-URBANS (Horizon Europe) project
 - Building on estimates made in EUCAARI & TRANSPHORM (FP6) projects ~10yrs ago
 - See as initial estimates, to be further refined
- > Large uncertainties: particle numbers (PN) instead of mass
- > Particle size range 10-325 nm (pragmatic choice: difficult to measure smaller particles, and they coagulate faster to larger particles)
- > Total particles (not only solids)
- > Year 2018, spatially distributed at resolution 6x6 km² to support UFP modelling
- > Transport sources are the most important sources

First draft results



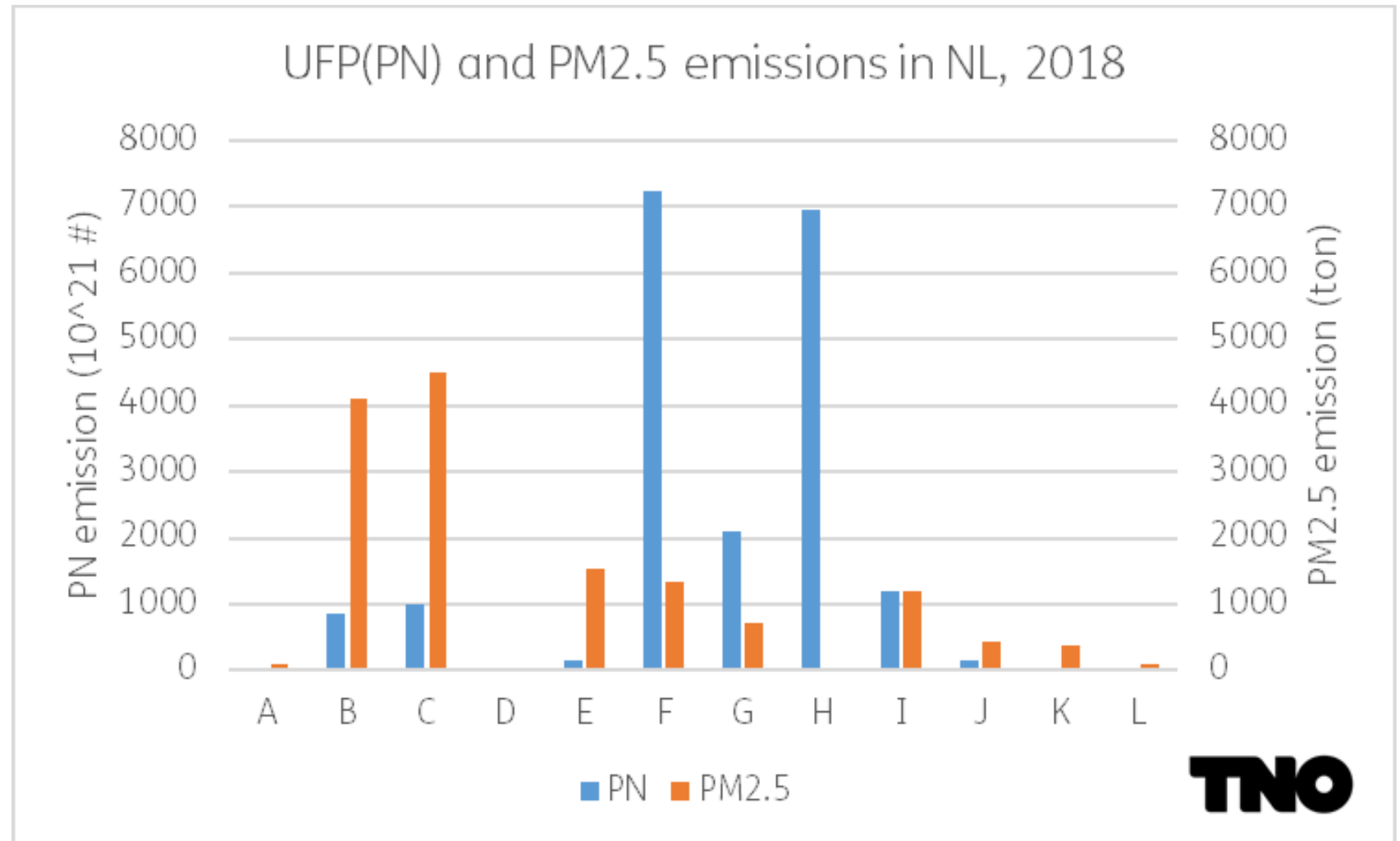
GNFR category	Description	PN emission in #10 ²¹	Contr. to total in %
A_PublicPower	Power and heat production	85	0.4
B_Industry	All industry	847	4.3
C_OtherStationaryComb	Small combustion incl households	1013	5.1
D_Fugitive	Fugitives from energy production	0	0
E_Solvents	Solvents and other product use	162	0.8
F_RoadTransport	(diesel) Exhaust emiss. and wear	7221	36.6
G_Shipping	Only within country, not offshore	2085	10.6
H_Aviation	Only Landing- and Take Off cycles	6950	35.2
I_Offroad	All other mobile sources	1203	6.1
J_Waste	Waste processing	153	0.8
K_AgriLivestock	Agriculture cattle stock	0	0
L_AgriOther	Agriculture other	1	0
Total		19721	100



Comparing UFP (PN) to PM2.5

Most important sources are different for UFP and PM:

- UFP: Mobile sources
- PM: industry and domestic





Emission estimation methodology: possibilities

- > Emission factors from literature (measured): PN amount per unit of activity. But only available for a limited number of sources
- > For the other sources: derived from PM_{2.5}, estimation based on mass fractions and particle size distributions. Introduces uncertainties.
- > Particle size: option: divide in 15 'size bins' for total range 10-300 nm
- > This is the beginning. More desk research is required
- > Condensables included?
- > Do sulphur emissions lead to primary UFP?
- > Update required for transport EFs and particle size distributions



And now ... Implement UFP data in the emissions inventories !

