Change in future air pollution exposure due to changing emissions & climate Stockholm

Christer Johansson[1,2] & Camilla Andersson[3]

[1] Department of Environmental Science and Analytical Chemistry, Stockholm universty, Sweden,
[2] Enviroment and Health administration, Stockholm, 3Swedish Meteorologicaland Hydrological Institute, Norrköping.

Objectives

The main objective of this work is to investigate the impact on future population exposure of climate change versus emission changes.

Methods

For NOx and PM-exhaust we compare health benefits of three mitigation strategies - a motorway bypass outside Stockholm [1], no exhaust emissions (electric fleet), and a fossil free vehicle fleet - with climate change effects on the exposure. For O_3 we compare changes in exposure due to European and local emissions. We take into account effects of large-scale global climate change to fine-scale local emission change. The effects on NOx and PM exposure are investigated using a Gaussian dispersion model at 100m resolution. For surface ozone, we used nested model calculations from global (50 km) to local scale (1 km over Stockholm). An Eulerian chemistry-transport model (MATCH) was used to analyse impacts on the air quality 2050 of climate change compared with changing European and local emissions. MATCH includes ozone- and aerosol-forming photochemistry with 60 species.

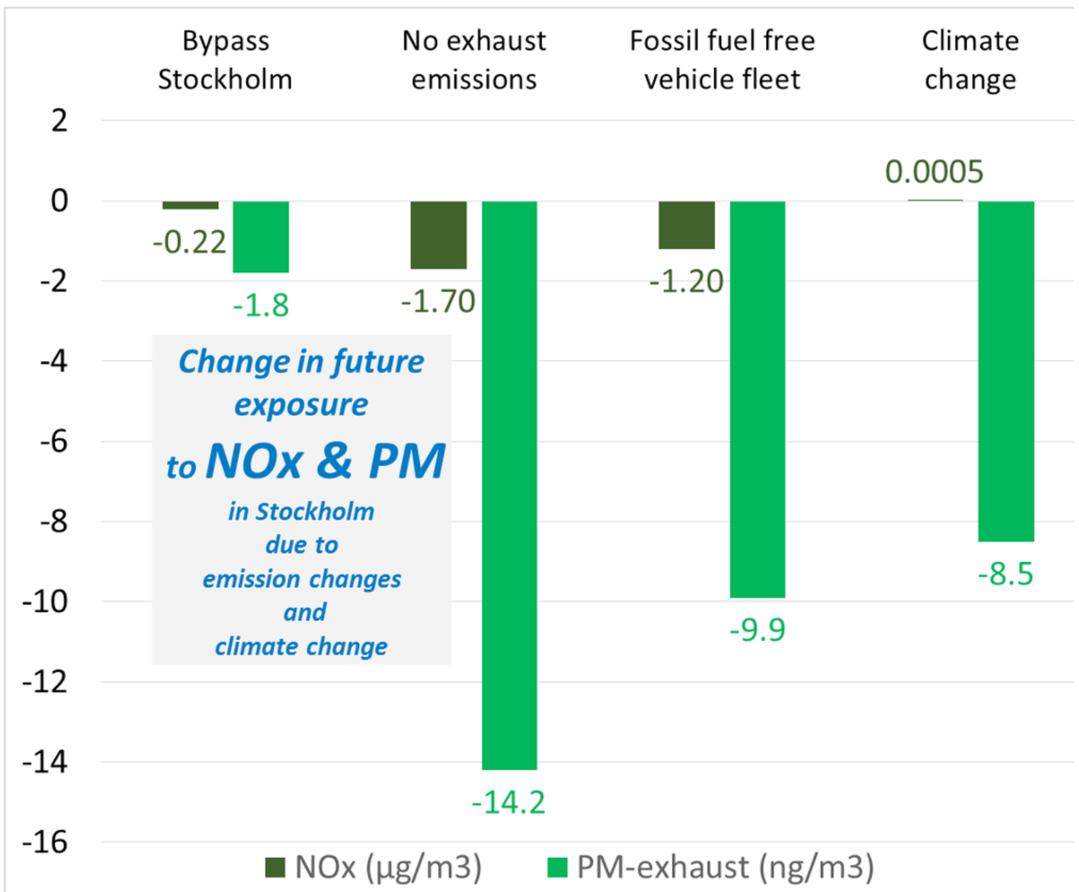

Figure 1. Change in population weighted exposure concentrations for the three emission scenarios and one climate change scenario for the Greater Stockholm area (ca 1.6 million inhabitants).

Accknowledgement

This project was funded by the Swedish Environmental Protection Agency as part of the ERA-Envhealth action plan.

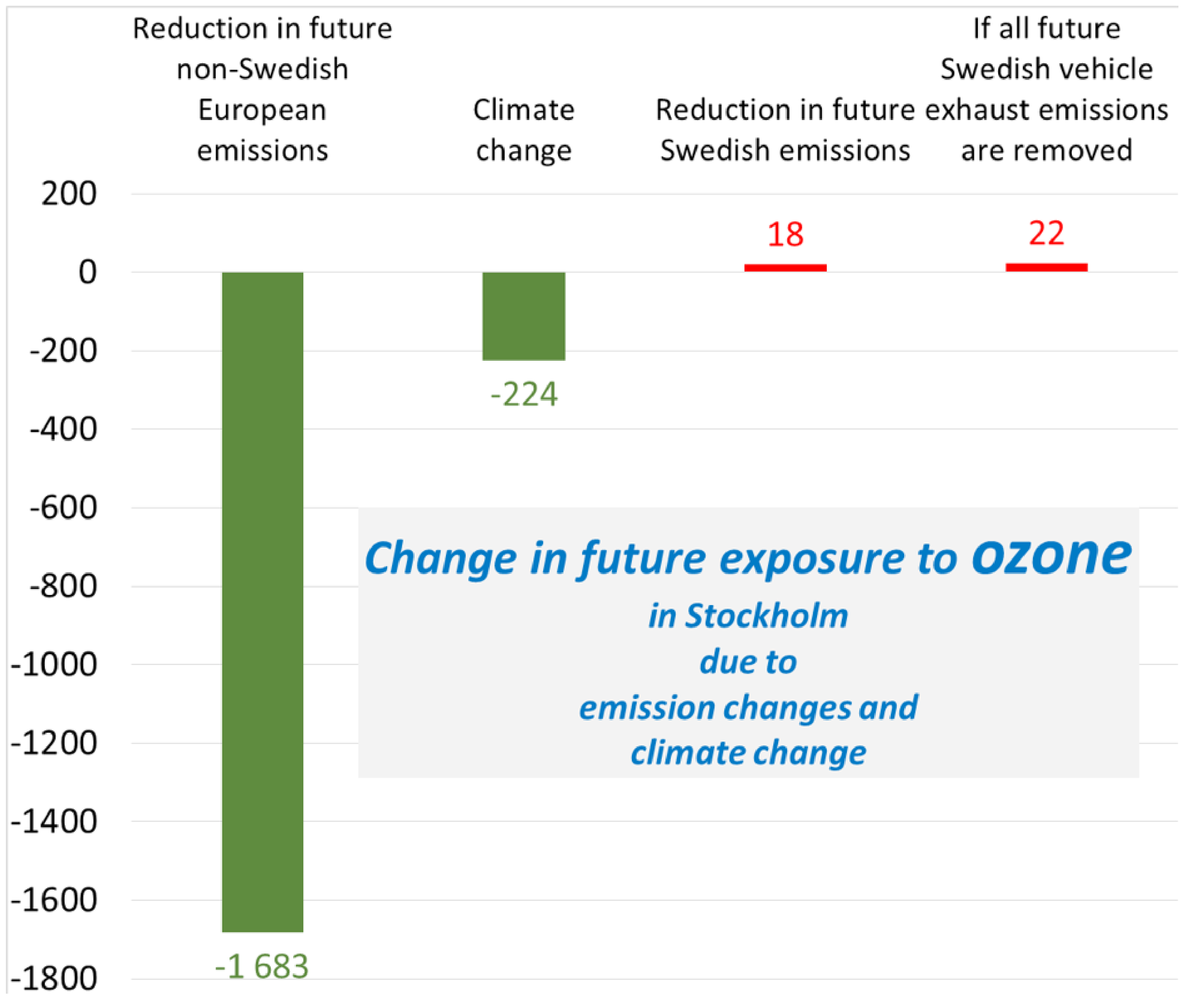

Figure 2. Change in population weighted exposure ozone concentrations (SOMO35, µg m^{-3}) due to changes in precursor emissions in Europe and Stockholm, climate change, and if all exhaust emissions in Stockholm would be removed.

Results

Figure 1 shows the potential reduction in NOx and PM-exhaust exposure of introducing a fossil fuel free (FFF) vehicle fleet compared to removing all exhaust emissions. In the FFF fleet we assume that all diesel and gasoline vehicles would be electric and the remaining emissions (difference between no exhaust and fossil free) are due to existing ethanol, biogas and biodiesel vehicle emissions. It is seen that the planned bypass will be much less beneficial for reduced population exposure compared to the FFF scenario and that climate change alone is almost as beneficial as the FFF scenario for Exhaust-PM, but not for NOx exposure.

Future O_3 exposure in Stockholm will decrease due to projected lower European precursor emissions (Figure 2). If the emissions would be the same climate change alone is predicted to cause lower ozone exposure, but the effect is very small compared to lower European emissions. Exchanging all vehicles to electric will cause increasing ozone exposure in Stockholm (due to less NOx), but this is a very small effect compared to the decrease of ozone exposure in Stockholm due to climate change alone.