New and emerging technologies: Impact on air quality and climate

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One of the most prominent characteristics of current new and emerging technologies is a reduced demand of energy and an effective contribution to mitigate climate change. This is most efficiently achieved by increased or more effective use of catalysis and/or CO2 free or neutral technologies. What is quite often forgotten, however, is that climate mitigation – with the exception of direct savings in CO2 emissions – is closely related to air quality and vice versa. For example: The introduction of alternative fuels (ethanol, bio-Diesel) is expected to change the particulate emissions from combustion engines and to contribute to peroxyacetyl nitrate (PAN) formation. PAN is a powerful respiratory and eye irritant, present in photochemical smog and – as a result of its atmospheric lifetime – it impacts on the spatial distribution of NOx. Emissions such as CO, NOx, CH4, ozone, hydrocarbons and soot are also involved in climate forcing and are therefore termed non-CO2 `short-lived climate forcers (SLCFs)´. Since such emissions are extremely relevant to the air quality in almost all larger urbanizations and megacities in the world, they represent an important case of climate-air quality interaction. For example, the reduction of global soot emissions would cause CO2 induced climate change to be substantially delayed. Attempts to reduce NOx emissions from Diesel engines by SCR catalysts (selective catalytic reduction) can cause emissions of NH3 (in Ad-blue technologies) and N2O to increase. In fact, emissions of NH3 can be even more relevant for Otto engines with 3-way catalysts compared to SCR systems under certain operation conditions. Additionally, attempts to reduce hydrocarbon and CO emissions by oxidation catalysts have led to increased NO2 emissions from the oxidation of NO. In Germany, the emissions of NO2 and NH3 contribute to exceedances in emission ceilings of these compounds. Moreover, they are inhalation toxicants as well as precursors of secondary aerosols and therefore are of significance for air quality. The emissions of N2O are climate relevant, although their major sources are from biological activities of fertilizers in soil. Carbon capture technologies in power stations rely on the use of various amines to catalyze the capture of CO2 in aqueous solutions. Such amines may form toxic nitrosamines in the presence of NOx or are emitted into the atmosphere where they change the atmospheric particulate composition. Heating facilities involving wood combustion (pellets) are a substantial source of fine particles and polycyclic aromatics including the toxic benzo(a)pyrene. This causes net savings in CO2 emissions on the expense of substantial changes in air quality standards. The VDI Expert Forum focusses on the identification and analysis of the interrelations between air quality and climate change that are associated with various new and emerging technologies. The specific aim is the attempt to quantify such effects with respect to unexpected consequences and their local, regional and global significance. The motivation is the integrated assessment of technologies prior to their full implementations into industrial and/or societal applications....

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