Needs, Potentials and Challenges of Integrating Air Quality and Climate Change Policies

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Issue: Climate change and air pollution are two of the most challenging global environmental problems. There is an international consensus to limit global warming to 2°C to keep climate impacts manageable. By 2050 the single most important global environmental cause of premature death is projected to be air pollution.

Potential: Air pollutants and greenhouse gases (GHGs) are often emitted from the same sources. Ambitious climate mitigation actions can have significant benefits for air quality. Simultaneously reducing certain short-lived climate-forcing air pollutants (SLCPs), especially black carbon, methane and ozone, can slow temperature increase within the next decades. An integrated strategy tackling climate change and air pollution will reduce the policy costs and generate a net welfare benefit at the global level.[1]

Challenge: Some measures for climate change can "backfire" on air quality and vice versa, resulting in a conflict of interests. For example, promoting the combustion of biomass for climate change mitigation leads to higher emissions of air pollutants. At the same time, some pollutants that are reduced under the air quality regime currently exert a cooling effect on climate, yet are harmful to human health. An integrated policy would assess the options and make decisions considering both perspectives.

Recommendation: Coordinated action across the air quality and climate change policy sectors can help avoid trade-offs and optimize the benefits for climate, air quality and related expenses. Sufficient information is already available to make effective decisions that are coordinated in both directions.

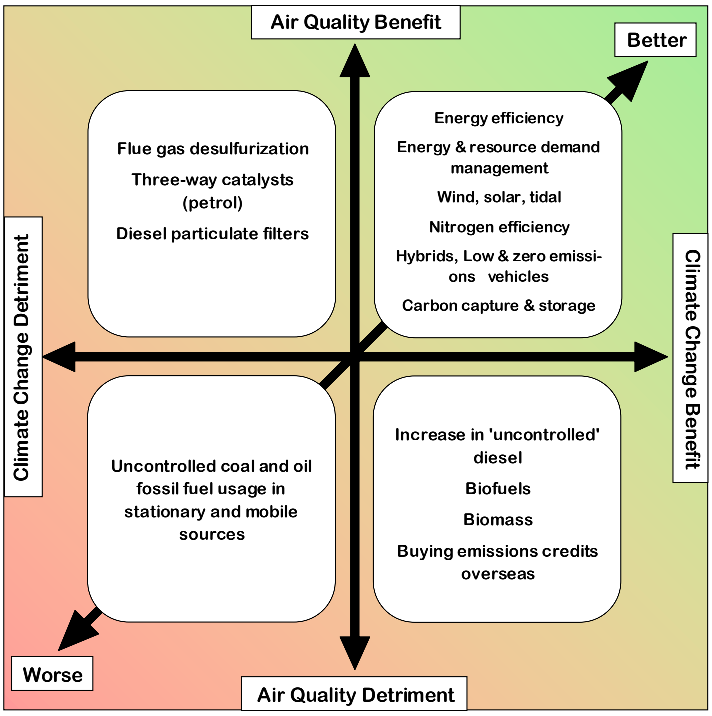

Figure 1. Air quality and climate change trade-offs and co-benefits of policy options[2,3].

Why does it make sense to consider air pollution and climate change issues jointly?

Climate change is one of the paramount environmental challenges we are currently facing. A projected impact of climate change is degraded air quality, an effect known as the 'climate penalty'.[4] While contemporary air pollution is often considered a problem that has been solved in Europe, in recent years, it was estimated that more than 80 % of Europe's urban population was exposed to particulate matter and ground-level ozone above the World Health Organization's limit recommendations.[5] Furthermore, air pollution is projected to be the top environmental cause globally of premature death by 2050[6], while at the same time many air pollutants play an important role in climate change. For example, black carbon has recently been identified as the second largest climate forcer after CO_2.[7]

Air pollutants and climate forcers are often emitted from the same sources. Well known examples of sources are road traffic or coal-fired power plants: both emit large quantities of carbon dioxide (CO_2), nitrogen oxides (NO_x), and particulate matter (PM), among other substances. The potential for co-benefits in the policy sector when tackling such "multi-effect sources" stems from this significant overlap in emission sources. The benefits that climate change policies can have for air quality and vice versa are beginning to be recognized politically, such as in the EU Flagship Initiative for 'A Resource Efficient Europe', which specifically supports low carbon technologies[8] that have the potential to simultaneously reduce the emission of GHGs and air pollutants.

Another targeted approach addressing climate change and air quality simultaneously focuses on short-lived climate-forcing air pollutants (SLCPs).[9] Among these, black carbon, methane, and ozone have major adverse health effects and cause significant damage to crops while simultaneously causing near-term global warming. An important difference, however, between SLCPs and long-lived GHGs is that the former remain in the atmosphere for only days to years, while CO_2 is long-lived, with an average lifetime of several centuries. Thus, SLCPs are important for short-term climate-benefits, while CO_2 is critical for the longer term.

Currently there are only a few integrated air quality and climate initiatives (e.g. the Climate and Clean Air Coalition, www.unep.org/ccac/ or the IGBP/IGAC Air Pollution & Climate Initiative, http://www.igacproject.org/AirPolClim), and they are in their infancy, so that very little action has yet been taken. This highlights the need for greater engagement on this topic from both the air quality and climate change science and policy sectors.

Potential

Co-benefits for air pollution through climate change mitigation policies

The socio-economic co-benefits to air quality are significant - on average about € 35 per ton CO_2 avoided.[10] For Europe specifically, if climate mitigation policies to achieve the 2°C climate target are implemented, it is estimated that 10 billion Euro could be saved annually within the air pollution control sector. Furthermore, 23,000 premature deaths yearly due to fine particulate matter ($PM_{2.5}$) and ozone could be avoided through 2030, compared to the baseline scenario in which no explicit climate policies are assumed. In addition, 15 % fewer forests would be subject to acidification and about 4 % fewer ecosystems would be harmed by eutrophication.[11]

Co-benefits for climate change mitigation through air pollution measures

Black carbon and methane mitigation strategies have the potential to reduce projected global warming between today and 2050 by ~0.5˚C.[9] In addition, because of the local nature of some SLCPs – particularly black carbon – local climate change impacts such as precipitation changes and glacier melting could be reduced within the countries where the emissions are decreased. In addition to the climate related benefits, it is also estimated that ozone and methane reduction would then prevent economic damage of over 3 billion Euros from wheat crop losses in Europe (based on the year 2000).[12]

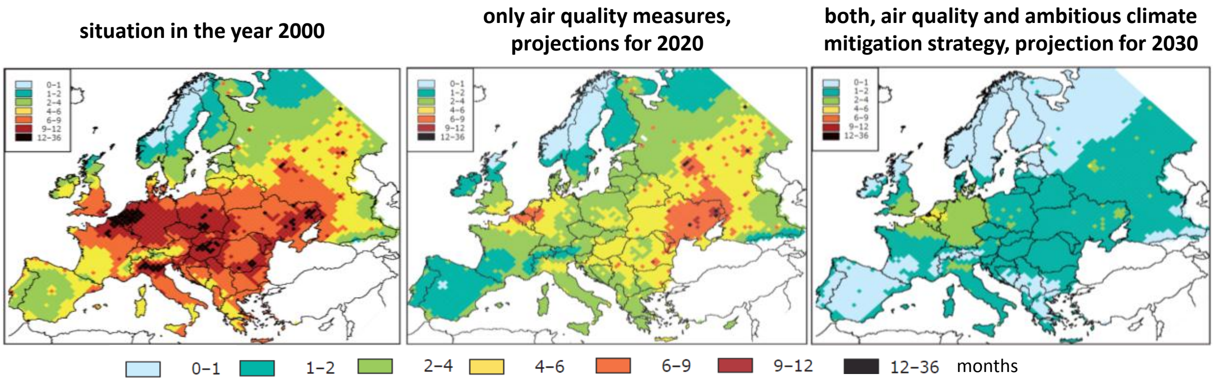

Figure 2: Loss in life expectancy (months) from anthropogenic $PM_{2.5}$ contributions (adapted from EEA 2006[11])

Challenge

Trade-offs for air quality through climate change mitigation measures

Some climate change mitigation measures can lead to increased air pollution.[3] Especially less ambitious climate change mitigation goals will foster small changes in technology and fuels, tending to worsen the situation rather than leading to co-benefits for air pollution. For example, the use of biomass as fuel for less net CO_2 emissions often leads to increased emissions of air pollutants. A significant fraction of PM from biomass burning emissions is black carbon. Under current legislation, domestic heating will be the largest source for black carbon (50 %) in Europe by 2030.[14]

Trade-offs for climate change mitigation through air pollution abatement

Current air pollution levels are estimated to have "masked" global warming by approximately 1 °C[14] due to the cooling effects of PM. This masking effect is mainly caused by the sulfate and nitrate components of PM which also have adverse health impacts and contribute to acidification, as well as by the organic PM components. Reducing these air pollutants could lead to an "unmasking" that further increases global warming. This should not imply that they should not be reduced, only that emission sources with significant cooling components require a thorough understanding of all positive and negative effects on both climate and air quality before targeted measures with the greatest benefit can be implemented.

Towards integrated action

Until recently, studies and actions that aimed at integrating air quality and climate change policies often focused on the minimization of costs rather than comparison of benefits and costs. Such approaches downgrade the value of co-benefits[Fehler! Textmarke nicht definiert.].[10] Directing the thinking towards maximizing co-benefits, there are several levels of action to take an integrated approach to climate and air policies:

Level 1 – Small scale technical measures: End-of-pipe technologies, such as filters to remove particles prior to emission or small scale installations, such as methane capture from landfills, are already available and can be implemented quickly. Such measures are useful for the immediate and narrowly targeted reduction of specific air pollutants and precursors that contribute to global warming, but require ancillary measures (see below).

Level 2 – Mid-scale technology and infrastructure based measures: Several measures required under the air quality legislation in Europe exist to reduce air pollutant emissions to keep ambient concentration levels within limits to protect human health. This is achieved by targeting individual sources (e.g. cars) and introducing moderate changes to city scale infrastructure, such as improving public transportation. Currently, such action taken under the air quality regime only takes into account the reduction of air pollutants. However, when implementing a low emission zone under an integrated approach, measures to reduce both air pollutants and GHGs could be implemented to create a truly *low* emission zone in a more holistic sense.

Level 3 – Changing large-scale infrastructure and affecting behavioral change: For a truly integrated approach, deep reaching systemic measures that modify large scale infrastructure for e.g., transport and energy, will be necessary to reduce or eliminate the common sources for GHGs and air pollutants. Areas such as private transport or domestic wood burning require not only systematic changes in policy and regulatory frameworks, but also behavioral change at the level of the individual to change habits that are often rooted deeply in culture.

Recommendations for the next steps

There are still many steps to take until Europe can claim an integrated policy approach. However, major steps have already been taken by acknowledging that air quality and climate policies are inexorably linked and by recognizing the need to tackle these challenges jointly. Recommended next steps are to:

- **consider climate impacts of current and new air quality measures** and vice versa to assess policies according to their multi-sectoral effects based on the information that is already available when (re)designing policy frameworks,
- **develop metrics** or indicators that measure co-benefits and trade-offs for air quality and climate change mitigation,
- **conduct studies driven from a policy perspective** with close cooperation between scientists, policy-makers and other major stakeholders, that identify co-benefits and trade-offs at the EU-scale focusing on comparing all benefits and costs rather than simply minimizing costs.

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Interdisciplinary and Global Working Group (IG-WG) on SLCPs
The aim of the WG is to explore and share knowledge on how emerging initiatives to mitigate climate change through SLCP reduction can be more effectively integrated across policy sectors in the joint context of socio-economic development, air pollution reduction, and broader climate change policy. The IG-WG is hosted by ClimPol Project at the IASS within the SIWA cluster. http://climpol.iass-potsdam.de/about/interdisciplinary-and-global-working-group

References:
[1]Netherlands Environmental Assessment Agency, PBL Report no. 500116005, February 2009, [2] Monks et al., Atmospheric Environment 43 (2009), [3] Williams, Carbon Management 3 (2012) ,[4] Jacob and Winner, Atmospheric Environment 43 (2009), [5] European Environment Agency, EEA Report No 4/2012, [6] Organization for Economic Co-operation and Development (OECD), 2012, [7] Bond et al., Journal of Geophysical Research-Atmospheres, 2013, [8]http://ec.europa.eu/resource-efficient-europe/, [9] United Nations Environment Program (UNEP), Synthesis Report, 2011, [10]Nemet et al. Environmental Research Letters 5 (2010), [11]European Environment Agency 2006, Technical report No 4/2006, [12]Centre for Ecology and Hydrology, ICP Vegetation Report, September 2011,[13] Amann, 2012, http://climpol.iass-potsdam.de/sites/climpol/files/wysiwyg/files/amann-russfrei.pdf, [14] Ramanathan and Feng, Atmospheric Environment 43 (2009)