CARBON PRICING LEADERSHIP COALITION

Briefing Note
DECEMBER 2019

Carbon Pricing, Climate Change, and Air Quality

KEY MESSAGES

- Air pollution is one of the world's main causes of mortality and disproportionately affects vulnerable population groups.
- The combustion of fossil fuels contributes to both local air pollution and global climate change. In many cases (but not in all[1]), climate change and air pollution share common sources.
- Carbon pricing initiatives (such as carbon taxes, emission trading systems and removal of fossil fuel subsidies), if designed well, disincentivize consumption of fossil fuels. These policies can reduce greenhouse gas emissions and local air pollutants simultaneously.
- Policymakers should consider linkages between climate and air pollution policies to maximize synergies while minimizing unintended consequences. For example, policies should cover all emissions and sectors. This would prevent a rise in air pollution caused by increased chemical reactions in polluted areas due to policies that reduce some pollutants and not others.
- Policy packages that have climate and air quality benefits combine short-term, local results with longer-term climate benefits. In fact, the benefits of improved air quality often outweigh climate policy costs. The packages need to be designed with a holistic approach that considers the various pollutants and the potential unintended consequences of specific design choices.
- The combination of climate and air quality benefits, if communicated effectively, can be used to build strong and diverse advocacy coalitions and increase political acceptance.
- Collaboration between and across all governance levels and all relevant research disciplines (such as economics, chemistry, and engineering) are needed to increase the understanding and maximize the air pollution benefits of carbon pricing.

AIR POLLUTION AND CLIMATE CHANGE

Air pollution and climate change share in many cases common origins as they are both primarily driven by fossil fuel combustion. Climate change policies based on energy efficiency and decarbonization of the energy model can lead to improved air quality, especially in cities.

Despite this link, air pollution and climate change have historically been regulated independently through separate policy frameworks. At the international level, there are different treaties, agreements, conventions, and protocols[2] for each type of pollutant, while at national levels, there are separate regulations, and in some cases also separate government departments, to control different pollutants.

Moving forward, climate change and air pollution will remain top priorities for governments across the globe. Rather than

combating them separately, there is a strong case for a coordinated policy approach to address both issues. Such an approach should be based on solid scientific evidence. To obtain accurate estimates, a joint cost-benefit analysis (the short, medium and long term) should be conducted while analysing the economic impacts of carbon pricing.

AIR POLLUTION, ITS SOURCES AND IMPACTS

Air pollution (see Box 1 for common air pollutants) is one of the main risk factors for human health worldwide. According to the World Health Organisation (WHO), indoor and outdoor air pollution cause around 7 million premature deaths each year. In 2013, it caused one in ten deaths globally, costing the global economy about $225 billion in lost labour income[3]. The most vulnerable population groups, such as ethnic minorities and lower-income communities, bear disproportionate air pollution burdens[4,5].

Geographically, urban areas are air pollution hot spots and the problem will escalate as the world's population increasingly concentrates in cities. Today, more than half of the world's population lives in rapidly expanding cities which generate about 80% of global GDP[8] and contribute more than 70% of global greenhouse gas emissions[9]. More than 80% of people living in these areas are exposed to air quality levels that exceed the WHO limits, and in low-income countries, this number rises to 98%[10]. Transport emissions are particularly damaging for health in cities since emissions are released in areas where people live and work.

However, cities are not the only hubs for air pollution. In many countries, factories (such as those producing cement, steel, and chemicals) are in rural areas. For example, in the Beijing-Tianjin-Hebei area of China, rural areas can suffer similar levels of air pollution compared to cities[11].

Regarding sources, most air pollution results from energy-related activities (Figure 1). Nearly all sulfur dioxide and nitrogen oxides emissions are created by energy generation and consumption—such as through the combustion of coal and gas for power. $PM_{2.5}$ is also mostly emitted by energy activities, especially residential coal consumption.

Air pollution is generally considered a local phenomenon, although pollutants can also be transported long distances and sometimes form new types of pollutants far away from the initial source. The formation of air pollutants is a complex process and depends on several factors including: the level and type of economic activity, population density and volume, energy demand and mix, natural concentrations

Box 1: Air pollutants[6,7]

Air pollutants from human activities include:

- **Sulfur oxides (SO_x)** - in particular sulfur dioxide (SO_2), contained in fossil fuels.
- **Nitrogen oxides (NOx)** - generated in high-temperature combustion, or from the oxidation of NO to NO_2 in the atmosphere.
- **Particulate matter (PMx)** - a mixture of tiny solid or liquid particles in the air. Indicators of particulate matter usually refer to the mass of particles in a given size range, such as those with a diameter less than 10 µm (PM_{10}) or 2.5 µm ($PM_{2.5}$).
- **Black carbon** - a product of incomplete fossil fuel combustion, is a particular type of $PM_{2.5}$.
- **Carbon monoxide (CO)** - generated during the incomplete combustion of transport fuels, natural gas, coal or wood.
- **Volatile organic compounds (VOCs)** - released from chemicals, solvents or fuels as they evaporate.
- **Methane (CH4)** - released in agriculture and waste management activities and during extraction and transport of natural gas and coal.
- **Ammonia (NH3**) - released in agricultural and waste management activities.
- **Tropospheric (surface) ozone (O3) –** a secondary air pollutant formed mainly from NOx and VOCs in the presence of sunlight.
- **Smog - visible air pollution** (usually in cities) composed of nitrogen oxides, sulfur oxides, ozone, smoke and other particulates (PM_x).

Some of these pollutants, like black carbon, methane, tropospheric ozone, and hydrofluorocarbons (also known as Short-Lived Climate Pollutants), also contribute to climate change.

of pollutants, and meteorological conditions (such as wind, sunlight and temperature inversion[13]) which affect the rate of dispersion and permanence of air pollution.

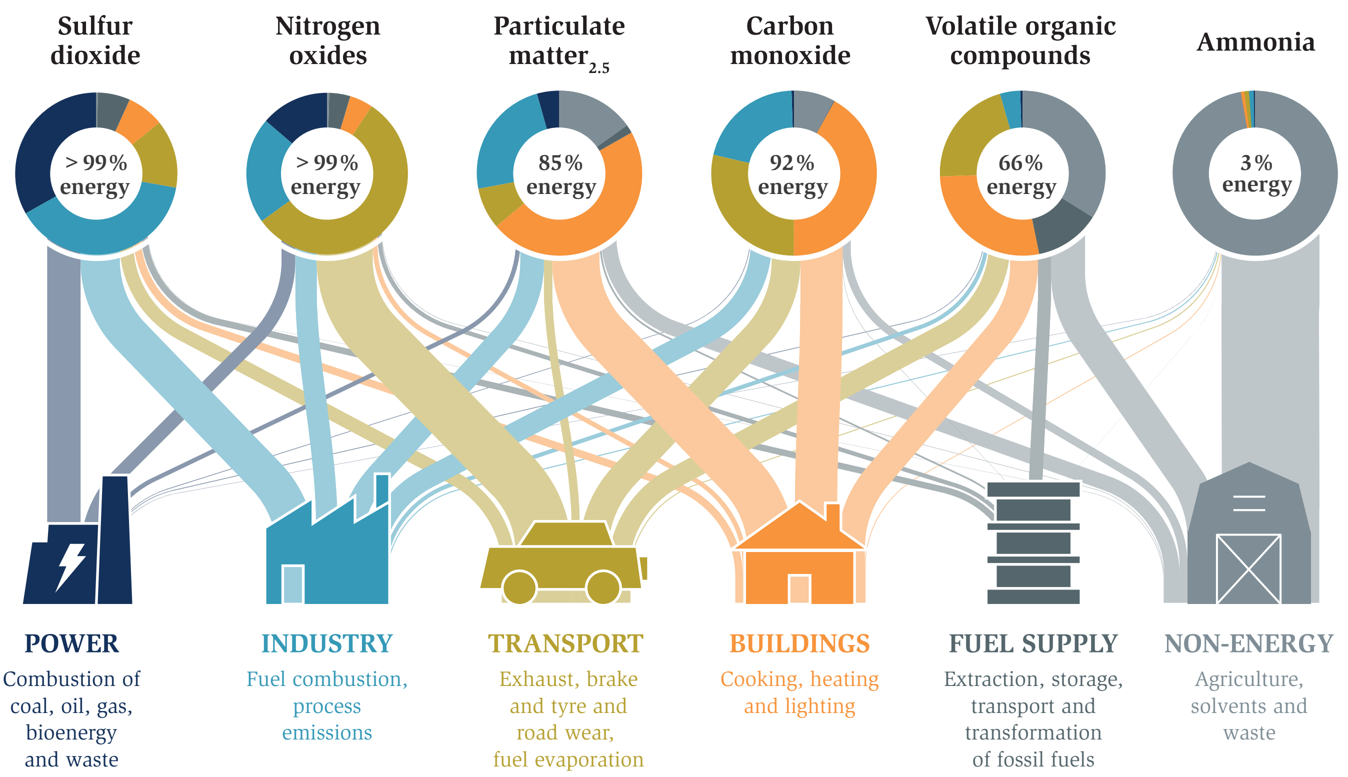
Air pollution has a wide range of impacts[14]:

- Reduces lung function, increases respiratory infections, and aggravates asthma
- Causes more than a third of deaths from heart stroke, lung cancer, and chronic respiratory disease, and more than a quarter of deaths from ischaemic heart disease
- Harms ecosystems by contributing to eutrophication and acidification of water and soil, leading to loss of flora and fauna
- Harms agricultural crops and forests causing yield losses that can lead to malnutrition and hunger
- Contributes to climate change through short-lived climate pollutants like black carbon, methane, tropospheric ozone, and hydrofluorocarbons
- Classifies as a human carcinogen[15] (outdoor air pollution)
- Enters the bloodstream causing cardiovascular, cerebrovascular and respiratory impacts ($PM_{2.5}$)

CLIMATE CHANGE POLICES AND THEIR AIR POLLUTION CO-IMPACTS

The quantification and understanding of common sources of pollution and the related health impacts of climate change and air pollution are gaining increasing relevance[16]. At the same time, the cases of coordinated policy approaches to address both problems are on the rise (see Box 2 below). Quantifying both the climate and health benefits of climate policies can reveal additional, and significant, co-benefits. The magnitude of these benefits can vary widely depending on the number of people exposed to pollution, pollutant concentration, meteorological conditions, mortality risk and the methodology used to monetize health impacts.

Figure 1: Selected primary air pollutants and their sources in 2015



Source: IEA (2016) Energy and Air Pollution - World Energy Outlook 2016 Special Report. All rights reserved. As modified by the Carbon Pricing Leadership Coalition.[12]

Nevertheless, these co-benefits provide additional value to climate change mitigation measures such as carbon pricing[17]. Additionally, in many cases, the co-benefits provide a stronger narrative for domestic policy implementation. For example, it can be easier to communicate short-term local health benefits than the longer-term global benefits of climate change mitigation.

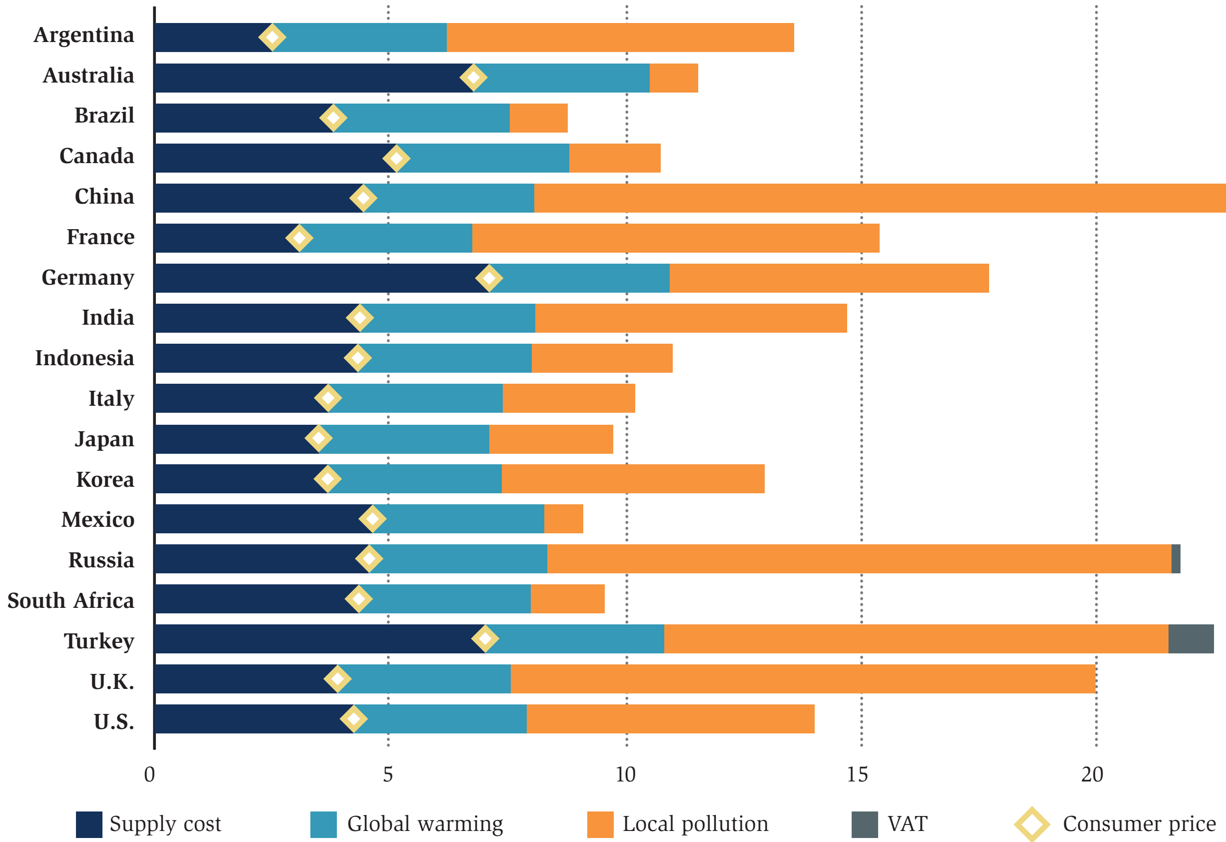
Figure 2 demonstrates corrected coal prices. The graph shows the coal consumer price compared to prices that include local air pollution costs, climate damage costs, and a VAT. As seen, air pollution damage costs exceed the global warming costs in more than half of the countries considered.

Research shows that for any country where the air pollution costs exceed the global warming costs—the latter based on a damage of US$40 per ton of CO_2—the ancillary air pollution reduction benefits would exceed $40 per ton of CO_2[19]. Other works quantify the air quality co-benefits of climate change mitigation in the range between $2 and $196 /t$CO_2$, with an average of $49 /t$CO_2$[20]. They also find that the ratio of health co-benefit to climate change mitigation cost ranges between 1.4 and 2.45[21]. In China, health co-benefits have been found to outweigh the policy costs of carbon pricing (as high as $132 per ton of CO_2 in 2030) to households[22].

In part due to these co-benefits, there is a rising awareness of the importance of coordinating climate change and air quality policies. For example, combined initiatives across governance levels, economic sectors, and scientific disciplines now include:

- International organizations, such as the Climate and Clean Air Coalition (CCAC), that have been successfully advocating for the integration of air quality and climate agendas[23].
- Reports by international bodies such as the European Environment Agency (EEA)[24] and the WHO[25].

Figure 2: Corrective coal tax estimates in selected countries in USD per GJ in 2013



Source: David Coady, Ian Parry and Baoping Shang, "Energy Price Reform: Lessons for Policymakers." Review of Environmental Economics and Policy 12: 197-219, 2018.[18]

- Government reports including by the United Kingdom[26] and the United States[27].
- Combined programs at the regional and city-level such as the Global Covenant of Mayors for Climate and Energy[28] and C40[29], who just recently launched the C40 Clean Air Cities Declaration[30].

Combined policy approaches could derive additional benefits:

- **Increasing political acceptance:** measures that combine climate and air quality and communicate the broader benefits could drive stronger policy advocacy coalitions (including for carbon pricing) among diverse stakeholders due to air quality's local, immediate, and more tangible health benefits.
- **Combining international and local governance:** climate change, a global issue, and air pollution, a local issue, could bring policy stakeholders, which are traditionally separated by scope, together to maximize efficiencies and benefits.
- **Expanding timing and reach:** addressing climate change and air pollution together will deliver both short-term (better air quality) and long-term (a more stable climate) benefits.

Box 2: Examples of coordinated approaches to air quality and climate change

CHILE – COMBINED TAX ON ELECTRICITY GENERATION

Chile has a green tax on electricity generation[31]. The country taxes emissions of both greenhouse gases (CO2 emissions) and local pollutants (PM_x, SO_2 and NO_x emissions). The policy also establishes a different tax rate according to the population of the area where the facility is located to facilitate emissions reductions in highly-polluted areas. Through this measure, both global warming and air pollution are addressed in a coordinated way, leading to greater benefits and lower administrative costs.

CALIFORNIA – 2017 LEGISLATIVE PACKAGE FOR ADDRESSING CLIMATE CHANGE AND AIR POLLUTION

In 2017, California extended its cap-and-trade program (AB398) and created new provisions for air pollution protection (AB617)[32]. Air pollution and climate are regulated by separate but coordinated laws addressing both stationary and mobile sources of CO2 and air pollutants. This ensures the simultaneous improvement of air quality and reduction of greenhouse gas emissions.

EU - GOVERNANCE OF THE ENERGY UNION AND CLIMATE ACTION[33]

In the European Union, there are specific clean air policies to address air pollution and climate packages to drive decarbonization. However, there is increasing evidence and awareness of the interdependencies. For example, the Regulation on the Governance of the Energy Union and Climate Action provides clear guidelines on the integrated national energy and climate plans to be developed by the Member States and pays particular attention to their impact on air quality and emissions of air pollutants.

CITY OF MADRID (SPAIN) – CITY AIR QUALITY AND CLIMATE CHANGE PLAN (PLAN A)

This local plan[34] aims to reduce air pollution, mitigate climate change, and define adaptation strategies for the city. The underlying view is that challenges related to air pollution and climate change need to be addressed jointly and require a coherent and integrated management policy. Specific targets are defined for the 2020 and 2030 timeframes and will be addressed through four action programs: 1) sustainable mobility, 2) urban regeneration, 3) climate change adaptation, and 4) citizen awareness-raising and collaboration with other public authorities.

CITY OF LONDON (ENGLAND) - AIR QUALITY AND CLIMATE CHANGE: INTEGRATING POLICY WITHIN LOCAL AUTHORITIES

In 2011, a report commissioned by the City of London[35] proposed that local authorities could conduct a coordinated analysis of the impact of specific environmental proposals on both climate change and air quality by classifying the measure according to its positive (green), possibly negative (amber) or certainly negative (red) effect on each problem (figure 3).

In contrast, uncoordinated approaches to air quality and climate change can foster counteractive policies. Certain policies can lead to the lock-in of technologies that address one problem but aggravate the other, the formation of pollution hot-spots, or equipment upgrades that ultimately release more carbon pollution. For example, in some cases, reducing certain local pollutants (such as NO_x and SO_x) and not others (such as VOC and CO) can lead to increased levels of air pollution (such as surface ozone and smog)[37]. The additional pollution is a result of chemical reactions in highly polluted areas, which has been occurring in some Chinese cities. Over the longer term, these mistakes must be corrected leading to stranded assets and/or additional policy costs. Policy coordination can identify when these effects may arise, minimize negative outcomes, and work towards policies/technologies that achieve mutually beneficial outcomes for air quality and climate change mitigation.

Figure 3: Example of a coordination table for climate change and air quality policy measures

Measure/technology	Impact on air quality	Impact on climate change	Page
Transport Measures			
Alternative fuels	Green	Green	21
Retrofit of exhaust abatement equipment	Green	Amber	22
Low emission zones	Green	Amber	23
Low emission strategies	Green	Green	24
Fleet management and driving training	Green	Green	25
Emmissions related car parking charges	Amber	Green	26
Travel plans	Green	Green	27
Car clubs	Green	Green	28
The Built Environment			
Domestic energy efficiency	Green	Green	30
Commercial energy efficienct	Green	Green	31
Combined heat and power	Amber	Green	32
Biomass heat	Red	Green	33
Micro wind turbines	Neutral	Green	34
Solar	Green	Green	35
Heat pumps	Green	Neutral	36

Source: Environmental Protection UK (2011): Air Quality and Climate Change: Integrating Policy Within Local Authorities https://www.environmental-protection.org.uk/wp-content/uploads/2013/07/aq_and_cc_guidance.pdf.[36]

Box 3: Examples of uncoordinated policies with unintended negative impacts

CLIMATE CHANGE MEASURES WITH NEGATIVE EFFECTS ON AIR QUALITY

1. **Diesel vehicles** have been incentivised in the EU (through lower indirect taxes) due to their lower CO2 emissions per kilometer. However, older diesel vehicles have higher PMx and NOx emissions per kilometer than gasoline vehicles. This policy is being reconsidered in some countries through measures such as a progressive balance of gasoline and diesel taxes or restrictions on the sale of new vehicles. However, the air pollution of new petrol and diesel passenger cars is not much different[38].
2. **Biomass electricity generation,** which can be considered zero-carbon (the CO2 emitted through the combustion process equals the amount of CO2 absorbed by the plant during its growth process), produces additional pollutants that can harm air quality and increase demand for land use[39].

AIR QUALITY MEASURES WITH NEGATIVE EFFECTS ON CLIMATE CHANGE

1. **In the EU, the installation of filters for SO2 emissions in coal generation facilities,** as mandated in 2016, would lead to lower SO2 emissions and a positive effect on air quality, but the technology would also reduce the efficiency of the facility, leading to higher CO2 emissions per MWh generated.
2. **Filters intended to remove particulate matter in vehicle diesel exhausts** would improve air quality, but they also require more energy consumption[40], potentially leading to additional CO2 emissions and operating costs.

KEY TAKEAWAYS & NEXT STEPS

Climate change and air pollution will remain key threats to the health of communities, especially those most vulnerable. Both problems stem primarily from fossil fuel consumption and require coordinated policy responses to mitigate their impacts. This brief covered several topics related to air pollution: 1) Its interaction with climate change; 2) Its negative health impacts; 3) Its co-benefits when addressed alongside climate change; and, 4) Examples of climate policy packages that address both issues and policies that address one problem, but inadvertently aggravate the other.

Moving forward, policymakers should consider both air pollution and climate change together when designing climate and environmental policies. Whether policymakers are currently focused primarily on air pollution or climate change, a comprehensive approach will lead to increased benefits and potentially stronger political coalitions.

MORE INFORMATION

Context: The Carbon Pricing Leadership Coalition (CPLC) is a voluntary partnership of governments, businesses, and civil society organizations working together to identify and address the key challenges to the successful use of carbon pricing to combat climate change. This Briefing Note was developed by Climate Strategies. It was authored by Marta Martinez Sanchez (Iberdrola) and Annela Anger-Kraavi (University of Cambridge). The Authors are grateful to Zhang Xiliang, Andrzej Błachowicz, Tom Erb, and Joseph Pryor for their input and guidance.

References: This Briefing Note is a synthesis of ideas and literature derived from the key references listed here.

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