

## POLICY PAPER

# Accelerating Black Carbon Reduction through EU-China Cooperation

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### Operational Priorities

- **Standardise Monitoring:** Co-develop harmonised Black Carbon (BC) monitoring and inventory methods by establishing a joint technical working group to align measurement protocols, implementing pilot monitoring in BC hotspot sectors using consistent approaches, and jointly assessing climate and health co-benefits to strengthen data comparability and policy relevance.
- **Policy Alignment:** Integrate BC into existing climate and air-quality policy frameworks through coordinated policy reviews, mutual referencing of standards, and joint guidance that prioritizes BC-intensive sectors such as residential heating and heavy-duty diesel transport.
- **Regional Cryosphere Action:** Launch a joint "Pole-to-Plateau" initiative on cryosphere protection, focused on reducing BC impacts in the Arctic and High-mountain Asia (HMA), supported by coordinated research, monitoring networks, and shared assessments of transboundary risks.
- **Capacity Building:** Establish a joint EU - China capacity-building and knowledge-sharing platform on BC mitigation, delivering targeted training, policy exchanges, and joint case studies on clean heating and low-emission transport, and conducting comparative assessments of key interventions to strengthen the evidence base and accelerate implementation in both regions.

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## Executive Summary

The Challenge & Opportunity: As a short-lived climate pollutant, Black Carbon (BC) is a primary driver of near-term warming and glacier melting with severe health effects, yet it remains a missing link in EU-China climate diplomacy. Unlike CO<sub>2</sub>, BC's short atmospheric lifetime means mitigation yields immediate results for both climate change and public health. By building on the respective strengths of the EU and China in policymaking, standards setting, monitoring frameworks, and technology deployment, both regions can focus on a very specific and measurable climate warming air pollutant to catalyse rapid synergetic progress in meeting respective climate and air quality objectives.

## Part I: Background: The Urgency to Act on Black Carbon

### 1. What is Black Carbon?

BC, often called soot, is a tiny particle produced when fuels like coal, diesel, wood, or biomass do not burn completely. Unlike carbon dioxide, which remains in the atmosphere for centuries, BC remains in the atmosphere for only a few days to weeks. This short lifespan means that cutting BC emissions can quickly improve air quality, reduce warming, and slow the melting of snow and ice in sensitive regions such as the Arctic and the HMA, also known as the Third Pole. Today, BC emissions mainly originate from four key areas (iGDP & WEF, 2024):

- Residential solid-fuel use for cooking and heating, one of the largest global contributors.
- Diesel-powered transport and machinery, including on-road vehicles, non-road equipment, and marine shipping that burn heavy fuel oil.
- Industrial combustion processes - such as brick kilns, coke production, and small industrial boilers - rely on inefficient technologies and lower-quality fuels.
- Open biomass burning, including agricultural residue burning and increasingly frequent wildfires.

## 2. Black Carbon and Its Significant Impacts

### 2.1 Global Climate Significance

BC is one of the key Short-Lived Climate Pollutants (SLCPs), alongside methane, tropospheric ozone, and hydrofluorocarbons (HFCs), which are collectively responsible for up to 45% of current anthropogenic warming. While BC's atmospheric lifetime is short (days to weeks), its potent, rapid warming effect is estimated to be up to 1,500 times stronger than CO<sub>2</sub> per unit mass (iGDP & WEF, 2024). The Intergovernmental Panel on Climate Change (IPCC) confirms that BC exerts a strong positive radiative forcing, meaning it warms the planet, by two main mechanisms: directly absorbing solar radiation in the atmosphere and reducing the albedo (reflectivity) of snow and ice surfaces, and thereby accelerating melting in places such as the Arctic and HMA.

However, the total net climate effect of BC emissions is subject to some scientific uncertainty. BC is nearly always co-emitted with other aerosols (like cooling sulfates) and gases. Therefore, policies targeting BC must consider that mitigation actions may also reduce the concentration of these co-emitted species, making the total resulting change in net radiative forcing complex to calculate. Despite this complexity, reducing BC remains a high-priority, "no-regrets" measure because: 1. It is a component of particulate matter (PM 2.5) and its reduction provides immediate, local health benefits alongside climate benefits; 2. Its short lifetime means mitigation can provide fast, visible cooling within a decade, buying critical time for broader, long-term CO<sub>2</sub> mitigation; 3. BC also affects regional rainfall and weather patterns, threatening food and water security in vulnerable regions (Lee et al., 2023; Pier et al., 2021).

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### 2.2 Health and Environmental Co-Benefits

As a major constituent of PM<sub>2.5</sub>, BC contributes significantly to the more than 8 million premature deaths to fine-particle pollution each year in the world. Exposure is linked to respiratory and cardiovascular diseases, elevated blood pressure, and adverse birth outcomes, disproportionately affecting marginalised populations. BC deposition on snow and ice reduces albedo, accelerating glacier and ice sheet melting in the Arctic, HMA, and Andes. Its impact on regional climate and weather patterns further exacerbates environmental and human risk. Therefore, reducing BC provides immediate co-benefits for human health, ecosystems, and climate stability.

## 3. Why EU-China Cooperation on Black Carbon Matters

The EU and China both face air quality and climate risks from BC, including health impacts and accelerated glacier melting in the Arctic and HMA. The latter jeopardises water security, destabilises regional climates, and undermines environmental resilience in both regions. In

the EU, BC emissions - particularly from shipping operating in the Arctic and northern waters - are associated with serious health impacts, such as heart disease and lung cancer (Osipova & Gore, 2025). In China, short and long-term BC exposure contributes to elevated premature mortality (Cui et al., 2022).

As key actors in global climate governance, the EU and China play a critical role in driving more coordinated international action on BC mitigation. Working together allows both polities to draw on their complementary strengths, including joint research and monitoring, shared technological solutions for transport, residential heating, and industry, as well as coordinated policy actions. A cooperative approach not only enables faster and more effective BC reductions but also delivers climate, health, and environmental benefits. This would further signal collective leadership on SLCPs and set a powerful example for global action.

The current governance frameworks of the EU and China present opportunities to accelerate BC emissions reduction. Since the 2012 amendment to the Gothenburg Protocol of the United Nations Economic Commission for Europe (UNECE), BC has been explicitly treated as a component of fine particulate matter (PM<sub>2.5</sub>) and targeted emission reductions. In the EU, these commitments are reflected through the EU Ambient Air Quality Directive, which sets monitoring requirements for BC, and the EU National Emission Reduction Commitments Directive (EEA, 2025), which promotes BC emissions reductions (CCAC, 2017).

Furthermore, maintaining the original ambition of the European Green Deal's Zero Pollution Action Plan, even as the policy focus shifts toward the Clean Industrial Plan, necessitates continued action on BC. Simultaneously, China is strengthening its environmental governance, as evidenced by its 2022 push for synergetic governance of climate mitigation and further tightening of air quality standards. This push is a direct institutional response to the long-recognised challenge that climate and air quality policy goals were historically pursued in separate policy silos, limiting the realisation of BC mitigation's co-benefits (Yamineva & Liu, 2019). By aligning these converging policy priorities, the EU and China can move beyond isolated efforts to launch a more coordinated and high-impact joint agenda.

With China and the EU-27 collectively accounting for an approximate range of 23-30% of global anthropogenic BC emissions, coordinated action by these two major economies provides significant global leverage. Accelerated BC reduction, led by EU-China cooperation, is a high-impact, 'no-regrets' measure that delivers important gains in: 1. Near-term climate cooling; 2. Human and ecosystem health; 3. Protection of vulnerable cryosphere regions and permafrost areas (Koven et al., 2011), as BC reduction offers direct, positive effects by limiting surface darkening, thereby slowing accelerated melting induced by BC deposits and climate warming.

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## Part II: Opportunities for Joint action on Black Carbon Reduction

### 1. Joint development of emission-inventories, monitoring and scientific research

Uncertainty in emission inventories and in the modelling of BC's climate and health impacts constitutes a significant barrier to effective BC reduction policies. This uncertainty was quantitatively demonstrated by a 2021 study which estimated the updated global BC inventory to be 32% higher than the average of earlier inventories (Xu et al., 2021).

China's Ministry of Ecology and Environment (MEE) has taken steps to integrate BC into its integrated air pollutant and greenhouse gas inventories. In 2024, it released the *Technical Guidelines for Compiling Integrated Emission Inventories of Air Pollutants and Greenhouse Gases (Trial)*, providing sector-specific methodologies for estimating BC emissions from key sources such as residential combustion and industrial process (MEE, 2024).

Meanwhile, the EU also has strong monitoring networks and methods that could complement China's large-scale but regionally heterogeneous monitoring network. For example, the EU has extensive experience through its European Monitoring and Evaluation Programme (EMEP) under the UNECE Convention on Long-Range Transboundary Air Pollution, which includes BC as part of PM<sub>2.5</sub> monitoring. Additionally, the European Environment Agency (EEA) coordinates national air-quality networks that measure BC concentrations using standardised protocols, ensuring comparability across Member States. Cooperation could focus on the following areas:

- Establishing a joint EU - China technical working group on BC and SLCPs would create a platform to share measurement protocols and BC emission factor data.
- Both sides could launch pilot monitoring activities in "hotspot" sectors, such as heavy-duty diesel transport and residential heating in both China and EU member states, using consistent methodologies so that the data are comparable.
- Expanding joint modelling studies to assess the regional climate and health co-benefits of BC reduction, which could build on ongoing EU-China scientific cooperation facilitated by institutions such as IIASA.

Together, these cooperation areas would improve the accuracy and consistency of BC emission inventories in both the EU and China, strengthening the foundation for more effective policy designs and regulatory interventions. They would also reinforce broader environmental cooperation under existing mechanisms, such as the EU-China High-Level Environment and Climate Dialogue (HECD), the China Council for International Cooperation on Environment and Development (CCICED), and the IPCC's 2024 agreement to the outline of the 2027 IPCC Methodology Report on Inventories for Short-lived Climate Forcers (IPCC, 2024).

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## 2. Standards alignment and the integration of BC into regulatory frameworks

Another barrier to advancing BC mitigation is that BC often slips through the cracks of climate mitigation and air pollution reduction policy silos. This separation was identified as a critical institutional barrier that hindered effective BC reduction in China (Yamineva & Liu, 2019). Typically, climate mitigation still largely focuses on greenhouse gases, while air pollution targets PM2.5 and ground ozone. As a result, BC tends to be underprioritised and is rarely included in national climate targets.

Currently, the inclusion of BC in Nationally Determined Contributions (NDCs) is indeed limited, with only a handful of countries addressing it in their climate action plans (Malley et al., 2023). At the international level, BC is covered mainly through regional agreements such as the Gothenburg Protocol. The other is the Arctic Council's Framework for Action on Enhanced Black Carbon and Methane Emissions Reductions, under which Arctic states set a collective target for reducing BC emissions by 25% to 33% below 2013 levels by 2025 (Council, 2015). The EU-China cooperation could help bridge these gaps by aligning standards for BC emissions in key sectors such as:

- Residential heating, shipping, and heavy-duty transport, so that standards are compatible across the EU and China. As heavy-duty vehicles (HDVs) contribute a substantial share of road transport CO<sub>2</sub> emissions in both the EU and China (Khanna et al., 2021; Rexeis et al., 2018), both sides could coordinate standards for electric HDVs in partnership with leading manufacturers to accelerate progress on one of the transport sector's most pressing challenges.
- Integrating BC reduction into existing regulatory frameworks by drawing on each other's policy approaches, such as China's synergetic approach to air-pollution-and-carbon governance, and the EU's updated Ambient Air Quality Directive, which now highlights BC. This cooperation can help both sides strengthen regulatory coherence and prioritize BC-intensive sectors.
- Coordinated advocacy in international fora, such as increasing international engagement with the Climate and Clean Air Coalition (CCAC) by upgrading its current observer role to partner, to raise the visibility of BC in global climate discussions and encouraging its inclusion as an explicit mitigation target.

Such cooperation would support greater alignment of standards, reducing barriers to technology-deployment and enabling economies of scale for BC-reduction technologies. Joint actions would also help build investor confidence and encourage private sector uptake of cleaner technologies. The policy exchange would help ensure that BC mitigation becomes an integral part of both parties' climate and air-quality strategies.

### 3. Transboundary and regional cooperation in cryosphere

As both the EU and China are facing growing risks from accelerating ice and snow melt, BC emerges as a shared concern. The Arctic is warming four times faster than the global average, with BC playing a major role in accelerating ice melting (Ohata et al., 2021). While emissions within the Arctic region have a disproportionately high warming impact per unit, BC from non-Arctic states, principally in East and South Asia, is transported via the atmosphere and represents a major contributing factor to the overall BC burden and subsequent warming effect on the Arctic cryosphere, especially during the spring and summer melting seasons (AMAP, 2021). In HMA, glaciers are also retreating at unprecedented rates. Studies show that BC reduces summer precipitation over the southern Tibetan Plateau, contributing to an average glacier mass loss of 11% from 2007–2016, rising to over 22% in parts of the HMA (Yang et al., 2022). Because BC crosses borders and drives regional climate and air-quality impacts, EU-China cooperation is essential to address these shared risks and externalities effectively. The potential cooperation could cover the following areas:

- Developing joint research on BC deposition and cryosphere impacts, such as establishing coordinated research initiatives on BC's role in glacier melting across the HMA, Arctic, and European mountain regions. This could include a joint monitoring network - linking remote sensing systems and ground stations in both regions to track BC transport and deposition. Such cooperation could build on existing international efforts under the International Cryosphere Climate Initiative (ICCI).
- Exploring a regional platform for BC mitigation: The Arctic Council's BC Framework sets a strong precedent for international climate cooperation by formally encouraging Observer States (such as India) to submit progress reports (Secretariat, 2020). A similar regional mechanism for HMA could enable non-Arctic nations, including China, to voluntarily contribute to BC mitigation efforts, thereby addressing the significant warming impact of its emissions on both the HMA cryosphere and Arctic melting simultaneously.
- A regional platform could also support shared early-warning systems and response frameworks for BC-intensive events such as wildfires (whose increasing intensity and area elevates BC emissions episodically and can offset anthropogenic gains) and open biomass burning, which have significant transboundary impacts.

The cooperation could enable both sides to better manage the cross-border climate and health risks from BC. It would also elevate global attention to the urgency of protecting glaciers and other vulnerable cryosphere regions, while creating momentum for broader multilateral cooperation.

#### 4. Capacity-building and knowledge sharing for black carbon mitigation

Both the EU and China are already implementing a range of measures to reduce BC across key sectors. China has extensive experience with large-scale deployment, such as its clean heating program and widespread adoption of heat pumps in northern provinces, as well as with the tightening of fuel quality and emission standards for heavy-duty diesel trucks. And the EU, with its Ecodesign Directive, sets stricter energy efficiency and emission standards for heating appliances, reducing BC emissions from residential heating. These complementary experiences create opportunities for mutual learning. Because governments cannot prioritise interventions or track progress without relevant information, sharing more data and policy experience on clean-heating transitions, vehicle emission controls, and technology deployment could help both sides speed up sectoral transformation and strengthen their regulatory capacity. Joint capacity-building opportunities could be:

- Training programs and knowledge-exchange workshops for regulators, local governments, and researchers on designing and implementing BC mitigation measures. These could highlight best practices across sectors and generate joint EU-China case studies to raise public and policymaker awareness.
- Collaborative assessments of key interventions, such as residential fuel switching or heavy-duty vehicle retrofits, comparing effectiveness and costs in EU and Chinese contexts to strengthen the evidence base for future policy.

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Stronger capacity and shared knowledge will help both the EU and China accelerate BC mitigation, achieve greater climate and health benefits, and build a more aligned foundation for long-term cooperation.

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### **About the project:**

China and the European Union have already demonstrated their commitment to taking leading roles on tackling climate change and environmental protection. The EU Green Deal and Chinese Ecological Civilization concept both hold similar objectives towards green transition as an interconnected effort to create a more sustainable and resilient society.

This project seeks to further implement a multi-stakeholder initiative to strengthen long-term think tank engagement on Green Global Governance between China and the European Union.

Structured exchanges on green governance policy issues and collaboration between leading think tanks and academic institutions with policy- and decision-makers on both sides aim to institutionalize track 2 and 1.5 dialogue mechanisms to accompany respective EU-China high level and sectoral dialogues. The Action's aim is to increase awareness and knowledge about the EU's and China's policy developments on green governance at technical and political levels, enhancing mutual understanding, whilst building trust, exploring common ground, creating networks of partnerships and influencing policy processes.

Activities include

- online roundtables, networking and research sharing
- delegation visits and policy workshops, including track 1.5 and track 2.0 dialogues
- European-Chinese thematic definition glossary
- policy papers and studies

The project is implemented by

- Hanns Seidel Foundation (HSF) and
- Think Tank of the Ministry of Natural Resources including the Consulting and Research Center (CRC), the Research Center of Territorial & Spatial Planning and Research Centre (RCTSP) and the Land Consolidation and Rehabilitation Center (LCRC)

and has a duration of two years until October 2026.

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