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Black Carbon Mitigation Projects: Primer for Investors

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1 Introduction

Black carbon (BC) is known to cause adverse climate and health effects. It is emitted from the incomplete combustion of fossil fuels, biofuels, and biomass and is, therefore, near ubiquitous in every country's emission profile. Because BC emissions are short lived, however, their reduction is particularly promising since the benefits of mitigation can be realized much more quickly than for longer-lived emissions such as CO_2 and methane.

Many governments and international organizations have strong concerns about the high level of particulate emissions, including BC, and emission standards and other measures have been introduced to reduce their release. The goal of this document is to identify and promote a deeper understanding of the factors that affect BC emissions at the project level, as well as the challenges of implementation that should be considered by investors and developers.

2 Factors to Be Considered in Project Design

There are a number of opportunities to reduce BC emissions. The following are important factors to consider when planning and implementing BC mitigation projects.

2.1. Target a High Emissions Source

Targeting the highest emissions sources can often give the highest reductions. While the distribution of BC sources can vary considerably from region to region, diesel and biomass combustion are the largest sources of global anthropogenic BC emissions. Prime opportunities, therefore, include diesel vehicles and equipment and residential cookstoves in all regions and brick kilns and coke ovens in Asia. Another propitious opportunity would be flaring at oil and gas fields in Russia, Nigeria, and Algeria. However, this list of opportunities is far from exhaustive, and with a better understanding of reduction strategies, the opportunities are numerous.

2.2. Explore Different Fuels

Not all fuel is created equal. The type and quality of fuel have a big impact on BC emissions and thus represent major areas to achieve reductions. A common practice to cut BC for diesel engines, for example, is to use ultra-low-sulfur diesel (ULSD) fuel, which combined with advanced emissions after-treatment devices, can lower BC emissions up to 99%. Alternatively, projects may be able to substitute a different fuel entirely, such as natural gas, which emits practically no BC when burned. Switching from diesel to solar, electricity, or natural gas will also typically have important reductions and health benefits. However, switching to biofuels can actually increase BC emissions, so such projects require a carefully studied approach.

In general for fuel-switching, there are things to consider apart from the physical modification of the engine or vehicle. When using ULSD, a sufficient supply of the fuel needs to be available. Diesel particulate filters will quickly become clogged if operators use high-sulfur fuel, and the vehicles or equipment will no longer operate without costly repairs. For this reason, it is important to educate owners and operators, and to verify that diesel particulate filters remain operational throughout the project. (Because ULSD costs more than lower-grade diesel and active filters slightly lower vehicle efficiency, there have been cases where operators have removed particulate filters to save money).

2.3. Select Equipment Carefully

Equipment can make a huge difference in emissions, and a surefire way to reduce emissions is to include emission controls. If at all possible, the project developer should obtain specific information on the replacement equipment to make sure it is low emission with controls. Manufacturers may sell high-emission equipment or vehicles in a market that does not regulate them, so simply buying from a manufacturer that produces low-emission equipment internationally does not guarantee low emissions. Oversizing equipment can also reduce efficiency and lead to higher emissions.

Overall, careful planning can help lower costs and increase savings. Upgrading equipment to reduce emissions can often lead to energy efficiency savings, which can make the projects more economically attractive. For example, a bus company in Murmansk, Russia that upgraded its diesel bus fleet found that the energy savings, reduced maintenance, and longer operating hours allowed it to cost-effectively reduce emissions (https://oaarchive.arctic-council.org/handle/11374/389). Retrofitting equipment to add particulate controls may also be an option, but typically only for well-maintained, relatively new equipment.

2.4. Estimate Savings

Estimating savings gives quantifiable results, a baseline for which to compare, and the ability to track progress. As mentioned above, equipment manufacturers may be able to provide emission estimates. In addition, BC emissions can be estimated using emission factors or directly measured using instruments such as aethalometers. Emission factors attempt to relate the quantity of a pollutant (e.g., BC, particulate matter) with an activity. More information about emission factors, including a compilation of emission factors, can be found at the following EPA and EEA websites: https://www3.epa.gov/ttnchie1/ap42 and http://www.eea.europa.eu/publications/emep-eea-guidebook-2013.

Health impacts and economic value of changes can also be estimated. A good resource to perform a benefits assessment is the EPA's BenMAP tool, which can calculate the number and economic value of air pollution-related deaths and illnesses (https://www.epa.gov/benmap, currently under development). The community edition of the tool is an open-source computer program that was developed to be easy enough for beginners to use.

2.5. Consider Project Risks

Each project may be exposed to certain types of risk that limit reductions. For equipment, specifying emission controls in the procurement process is crucial. For example, do not assume that equipment imported from countries with more stringent emission standards will have more stringent emission controls. Maintenance of equipment and ensuring emission controls remain intact are also important. For fuel, if a cheaper fuel is available, consumers may pass over the high-quality fuel to save money. Similarly, be sure that appropriate fuel is available to the consumer.

2.6. Monitor and Verify Savings

To ensure that the project will produce and sustain the expected reductions, monitoring and verification are important. As discussed above, monitoring emissions can involve calculations (e.g., using emission factors to convert activity data or other quantitative measures into emissions) or direct measurement. Verifying energy use before and after the project is also important in calculating emission reductions. Monitoring should also include checks to ensure that equipment remains in place, operates as planned, and meets emission standards.

3. Future Research Steps

As shown in this document, a great deal is known about BC to successfully make meaningful emission reductions. But there still exist substantial gaps in knowledge that hinder projects from reaching their fullest potential. Below are areas of research that would provide better understanding in this capacity.

One of the most important among these is a way to convert metrics such as global warming potential from BC to a CO_2 equivalent. This would allow for easier tracking of BC mitigation projects, which could open up significant financing. Today, we have estimates of the potential forcing of BC, but the calculations for specific sites are complicated because BC's impact depends on the location of emissions and the amount of organic carbon that is co-emitted. Simplifying these calculations with tools or tables would help in encouraging projects (and policies) to reduce BC emissions.

Likewise, synthesizing information on the latest science to allow project developers to more easily target projects and calculate emission reductions could help in promoting projects and improving their design. For example, this could include clear information on specific project types, important design elements to consider, and how to calculate emission reductions.

Finally, more research is needed on emission factors in certain areas. One of these key areas is biofuels, especially given their prominence and ascendance in the fuel portfolio of many countries. Uncertainty in biofuel emission factors are relatively high today. Likewise, flaring emission factors have relatively high uncertainty, which may limit the appeal of flaring for mitigation projects in the near term. Clearer information on the emission factors for these types of projects would make these projects easier to implement and more certain to produce the desired emission reductions.

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