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CLEAN AIR TASK FORCE

April 14, 2010

House Select Committee on Energy Independence and Global Warming

March 16, 2010 Hearing: "Clearing the Smoke: Understanding the Impacts of Black Carbon Pollution"

Responses of the Clean Air Task Force to Additional Questions

1) Would eliminating or reducing black carbon emissions merely "buy us time" while we figure out how best to deal with GHG emissions, or do we need to include it as a critical component of a balanced portfolio of climate change actions?

We are out of time and must take all feasible steps simultaneously to slow, stop, and reverse global warming. As CATF testified at the hearing, addressing black carbon and the other short-lived climate forcing pollutants such as methane and ozone is not a substitute for enacting comprehensive climate change legislation to deal with carbon dioxide emissions. We are going to need both and then some in order to address the climate crisis. So, yes, addressing black carbon emissions is a critical component of a comprehensive approach to addressing climate change.

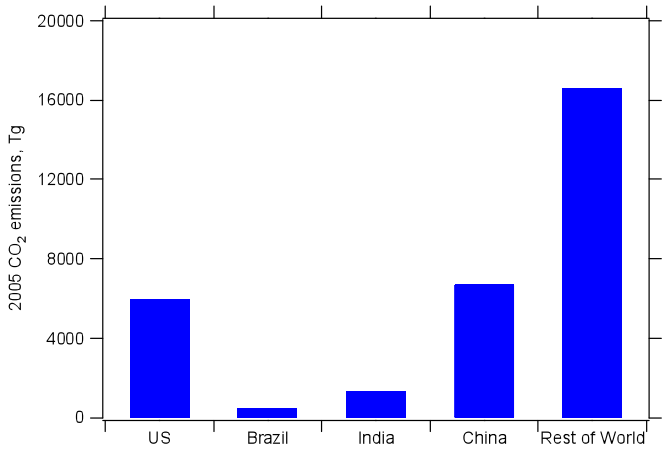
2) Why did the Kyoto Protocol fail to address black soot and other tropospheric ozone as methods of addressing global warming?

Thirteen years ago, when the Kyoto Protocol was negotiated, the importance of black soot and tropospheric ozone as short-lived climate forcing pollutants was much less well understood than it is today. Since that time, scientific research and assessments have clarified that these pollutants are important agents warming the climate.

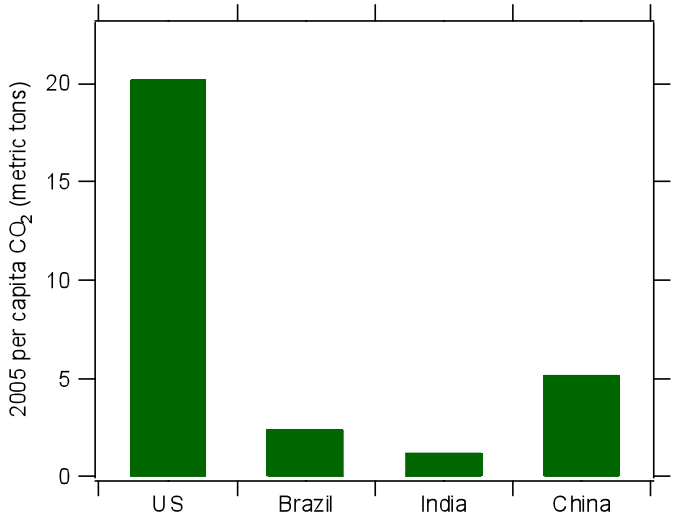
3) It seems that most GHG and black carbon emissions are coming from India, China and developing nations. Shouldn't efforts to address global warming be focused mainly on them?

To solve the climate crisis, each nation must take responsibility for reducing its emissions, an effort not as likely to succeed without international cooperation and

coordination. No nation can solve this problem on its own. Even if we could somehow magically zero out all of the GHG and black carbon emissions from China and India, we could not solve the problem. The same is true for the U.S. See bar charts below. Note also the per capita share of these emissions by nation.

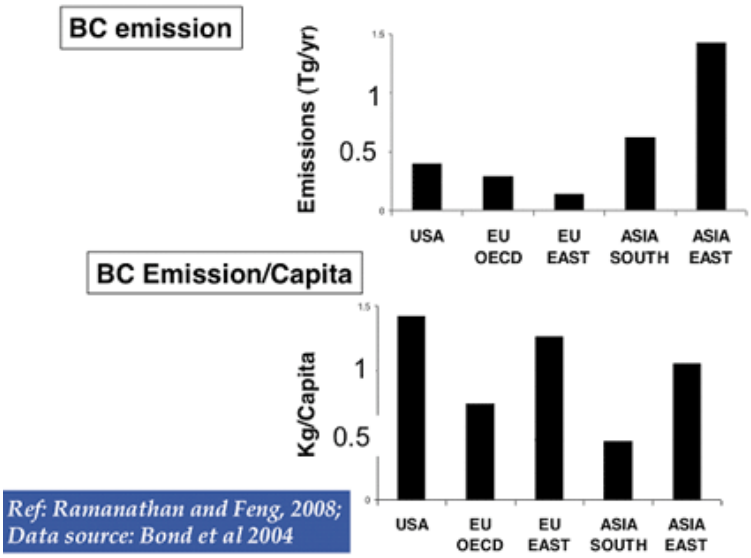


CO2 emissions by nation



Per Capita CO2 emissions

Data Sources for Graphs: Carbon Dioxide emissions from EDGAR - EC-JRC/PBL. EDGAR version 4.0. http://edgar.jrc.ec.europa.eu/, 2009. Population (2005) from the Population Reference Bureau: *2005 World Population Data Sheet*, http://www.prb.org/Publications/Datasheets/2005/2005WorldPopulationDataSheet.aspx, 2005.



BC emissions by nation and per capita

See: http://www.yaleclimatemediaforum.org/pics/0709_blackcarbon_1_431.gif

4) If the U.S. does not address black carbon, and only focuses on GHGs, then even if Congress passed a stringent cap and tax bill today, would the world still experience global warming from the continued black carbon emissions from some developing nations?

To solve the climate crisis, it will take all nations working together to address both carbon dioxide and the short-lived climate forcing agents (like black carbon, methane, and ozone). The most likely pathway to success involves joint international cooperation and action, not a blame game to justify inaction. The advantage of a focus on short-lived forcers like black carbon is that reducing their emissions will deliver immediate climate benefits because of their short residence life in the atmosphere. Reducing short-term climate forcing agents offers a very complimentary strategy to efforts to reduce longer-lived pollutants like carbon dioxide, which also need to begin immediately because they will take longer to counteract warming.

5) There is tremendous global pressure on developed countries like the U.S. to implement a cap and tax bill. Why is there not an equal push/pressure on developing countries to reduce black carbon emissions through elimination of inferior cooking stoves and the immediate replacement of inefficient diesel engines with new and more efficient products?

There needs to be more emphasis on reducing short-lived climate forcing agents <u>everywhere</u>, and the Waxman-Markey bill and this hearing were a good start. The U.S. must demonstrate leadership in this matter by significantly reducing U.S. diesel black carbon emissions (the largest domestic source) while helping facilitate reductions in other countries by encouraging adoption of more stringent diesel

emissions standards, the replacement of inefficient cook stoves, and the curtailment of agricultural burning in the spring. The comprehensive climate bills, such as the Waxman-Markey bill, feature a cap on carbon dioxide and other greenhouse gases. Carbon dioxide is the primary cause of observed warming to date, so reducing carbon dioxide is critical to any global warming mitigation strategy. But, the Waxman-Markey bill also includes measures to address short-lived climate forcers. The choice is not one or the other. Some strategies, like replacing inefficient, dirty cook stoves, present an opportunity to mitigate climate change by reducing both gases (CO2, CH4, N2O, CO) as well as black carbon. The stoves that achieve the greatest black carbon reductions also achieve the greatest overall reductions in unhealthful smoke, so there is a potential for a win-win.

6) What sort of mechanisms do you think the U.S. can implement to encourage foreign countries, specifically Russia and China, to reduce their black carbon output?

In China, 80 percent of the population uses solid fuels for cooking or heating. According to the World Health Organization, this practices leads to an estimated over 380,000 deaths per year.[1] In many parts of China, coal is used as the fuel for cooking, so moving from dirty, coal-fueled stoves to clean efficient stoves fueled either by renewable biomass or LPG has the potential to achieve even more substantial climate benefits in terms of both GHG and aerosols. China also has wide access to electricity, so that more advanced biomass stoves that require electricity to power a fan are more credibly an option today in China than in many parts of the world.

As for Russia and other countries that engage in agricultural burning, one mechanism by which the U.S. can encourage black carbon reductions is by supporting development and testing of pyrolysis equipment to convert biomass – such a crop wastes -- to biochar in a low oxygen environment. If designed and run correctly, these units can emit much few air pollutants, including black carbon, than would occur during traditional field burning. Biochar is the carbon (C) rich product that can then be applied to soil as a means to improve soil health, to filter and retain nutrients from percolating soil water, and to provide carbon storage.

A significant hurdle to full evaluation of biochar is the lack of available equipment for biochar production. Bench-scale units are available and have led to important advances in research, but they are not scalable in the field. There is an urgent need to develop prototype units capable of producing biochar from multiple feedstocks. The U.S. government could support this early stage production of equipment that would be capable of generating biochar from crop wastes and applying the char to agricultural fields.

[1] http://www.who.int/indoorair/publications/indoor_air_national_burden_estimate_revised.pdf at page 4.

7) Despite China's recent reductions in the number of older diesel engines, what has been the overall trend for China's black carbon output? Has the increase of vehicles in China and construction boom resulted in a net increase of black carbon?

The increase in the vehicle fleet and the construction boom in China are not expected to be large contributors to additional black carbon emissions there. Although the motor vehicle populations have increased in major cities by over 10% from 1995 to 2005, the growth rates of vehicular emissions of particulate emissions are much lower (compared to CO2), due to the implementation of more stringent vehicle emission standards.[2]

The Chinese Ministry of Construction estimates that 30 billion m^2 of new buildings will be built between 2005 and 2020.[3] This is likely to come from a combination of bricks, cement, steel and timber. Historically, coke and brick making have been significant sources of black carbon emissions. In the case of brick kilns, while black carbon measurements are nearly non-existent, particulate emission measurements and observation strongly suggest that primitive kilns are much higher emitter of black carbon than improved kilns. Because of this, China has been pushing for bricks produced from kilns with higher efficiency. The 'Tenth Five Year Plan' stipulated that by the end of 2005 the output of solid clay bricks (derived from the most inefficient and highest polluting kilns) should be reduced to 450 billion blocks (from 540 billion blocks in 2000). If this is reductions came to pass, brick emissions would be unlikely to cause a net increase in Chinese black carbon.

A portion of the construction materials will come from the steel and iron produced from coke making. As with brick kilns, while there are very limited measurements, primitive, indigenous coke ovens are significantly higher emitters of particulate matter—and black carbon -- than clean coke ovens. In 2006, China's coke production was roughly 300 million tonnes, accounting for 64% of the world's total coke production. A very rough calculation, based on current growth, predicts that China's coke production will double and reach 600 million tonnes in year 2020.[4] While this growth has the potential for significant black carbon emissions, a large fraction of China's primitive coke ovens have been phased out, and elimination of nearly all primitive coke oven production in China and replacement with modern kilns is expected to occur within the next several years.[5]

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[2] Wang, H. K., L. X. Fu, Y. Zhou, X. Du, and W. H. Ge (2010), Trends in vehicular emissions in China's mega cities from 1995 to 2005, Environ. Pollut., 158(2), 394-400.
[3] Ma, Y. and Bao, S.M. (2006) Status quo of building energy conservation and green building in China. China Construction Newspaper, 29 Match, P1
[4] Polenske, K.R, X. Zhang, S. Li, J. Li, and H. Liu (2009) *Cokemaking Report to the Clean Air Task Force*.
[5] China Mining, *China to eliminate 70 mln tons of small coke production facilities*, www.ChinaMining.org, 3/31/08, visited May 9, 2009.

The biggest unknown associated with black carbon emissions in China is the residential heating and cooking sectors. The black carbon emissions trajectory in China will be governed largely by how quickly cleaner fuels and improved stoves diffuse into the residential sector.

8) What is the cost of retrofitting existing diesel engines with the necessary diesel particulate filters? How much additional cost is added to clean diesel engines?

For on-road engines, the cost of retrofitting an existing engine with a passive diesel particulate filters ranges from ~$6500-$10,000. For non-road engines, the cost varies more but $15,000 is about the average (with a range from $10,000 to $60,000). For both on- and non-road engines, active diesel particulate filters generally cost more. EPA in its Regulatory Impact Analysis to the "2007 Heavy-Duty Engine" rule estimated an average incremental cost, for example, to a new Class 8 engine is about $3000. Because of the variety in engine horsepower in the non-road sector, the average per engine cost of the "Clean Air Non-Road – Tier 4" rule is harder to calculate. See: http://www.epa.gov/nonroad-diesel/2004fr/420r04007g.pdf at page 6-82 et seq. for the range of costs for example types of equipment.

9) How do you respond to the observation that diesel engine filters that reduce black carbon are known to reduce fuel efficiency and increase GHG emissions?

CATF and M.J. Bradley & Associates have performed a thorough literature search on this topic. The best evidence suggests that there is no fuel penalty (and therefore no increase in GHG emissions) from the installation of a diesel particulate filter (DPF). See: The Carbon Dioxide-Equivalent Benefits of Reducing Black Carbon Emissions from U.S. Class 8 Trucks Using Diesel Particulate Filters: A Preliminary Analysis Sept 10, 2009 pages 6-11, available online at:
www.catf.us/publications/reports/CATF-BC-DPF-Climate.pdf

10) How do you encourage poor people to purchase cooking stoves that are better for the environment, but cost more to heat their food than what they currently use? How do you deal with the cultural resistance/issues that lead to skeptical views of new technology?

This is an excellent question and goes to the core of why many past stove efforts have failed. Any solution that does not meet users' needs is doomed to fail. The basis of any solution must include offering not just stoves that are cleaner and more efficient in the lab, but ones people can afford, that cook the food people want to cook, at the time of day they want to cook, using available fuels, that can be repaired locally, and that do not substantially increase the time of cooking. However, a more subtle issue lurks here, too. Ideal solutions from an emissions perspective like Liquefied Petroleum Gas (LPG) -- essentially what we use in our gas stoves in the U.S. – may offer a "leapfrog" technology for many consumers in the developing world – from primitive biomass burning to a much cleaner cooking technology. Consumers would

recognize the value in switching to these stoves because LPG has several key characteristics as a fuel: you can start and stop it immediately, turn up or down the heat as needed (and so you can heat things quickly like tea, or simmer things a long time like stews), and, it is very clean and efficient. But everyone does not have access to LPG and most cannot afford it. So, there is a policy question about whether to invest in a leapfrog technology that would entail more expensive stoves and fuel supply issues vs. less expensive stoves that may face more consumer acceptance issues. Moreover, while it is important to be aware of meeting people's needs, it may be unnecessary to create a different solution for every village or region. One challenge is to develop other leapfrog technologies that can approximate the performance of LPG. One promising development in this regard is very clean advanced biomass stoves that are not as flexible as LPG stoves, but which have fans (and thus are nearly as clean) and that are adjustable. In addition, these technologies must be developed across a wide range of price points so that solutions are available for everyone, not only the relatively well-off among the world's poor. Such an effort will require support for applied R&D in all these areas to bring very clean, efficient, safe, reliable, and affordable solutions (stoves or fuel) to all.

Another part of the solution is relying on commercial markets to deliver stoves. Unlike government or research programs -- which often design to the donor needs (e.g., reducing black carbon) -- the private sector must design to the preferences of the customer. Private firms must test and retest stoves over and again with users before going to production. They typically mass produce only the stoves that people want. So, for example, they think about designing aspirational products that make people feel modern or better for other reasons, but are not sold solely based on the low emissions. And they would be more likely to sell stoves they can service. As a result, the stove ceases to be a handout, but rather becomes another consumer good that requires the full supply, distribution, and the type of service that we would expect. Adopting this perspective would entail a huge leap of imagination for this field, but a necessary one to deliver sustainable solutions at a very large scale.

Another leap forward has been the progress in learning what messages work in selling stoves. Once again, the messages again have to speak to the consumer, and they are different in different regions, for men vs. women, and in many other ways. The Shell Foundation has been a recent leader in this area and is starting to distill lessons from their public awareness campaign targeting three stove manufacturers in India.

Another key to the private sector's ability to sell stoves is the development of global standards as to what constitutes a clean stove. Absent that, anyone can make a stove and call it improved. The Waxman-Markey bill wisely includes such a set of standards. And once those standards are in place, consumers need credible, local sources to tell them which stoves meet the standards e.g., a network of national or regional stove testing centers.

Funding is also a key to success. Because more efficient stoves reduce carbon

dioxide, carbon financing is already helping stove sellers across the globe. But, it can be a very difficult, onerous process leading to a situation where few are able to get the financing, and many who do are beholden to large corporate entities that are willing to provide up-front financing (at considerable risk), but which then take nearly all of the value of the carbon credits, leaving little economic benefit behind. If a large public fund could be created to provide seed capital to stove businesses that had high quality stoves and a proven business model, these credits could instead be used to reduce the price of stoves to consumers, and also fund expansion of stove businesses, all of which would help make stoves cheaper and available to more people. See answer to Question 12. Village financing schemes are also important parts of any strategy, since the very poor will always have difficulty paying for even a decent, inexpensive stove. Microcredit tools could be invaluable in this regard.

Helping to reduce duties and tariffs for stoves that are mass-produced out of country is another way to make stoves more affordable. High quality stoves that are imported often see their price rise by as much as 10-20 percent due to these duties and tariffs.

In addition, recently some have proposed very innovative distribution ideas, such as giving high quality stoves to pregnant women that visit health clinics (reduced smoke exposure reduces infant mortality) including even giving them vouchers to encourage them to use the stoves (monitoring devices can now measure this). This would help reach the most vulnerable (the poor and children), and would critically not upset commercial business activity to sell stoves. Indeed, it may even be a good way to seed commercial markets by showing that improved stoves are so important that they are given to pregnant women. It is a scalable strategy – especially for the very poor – and could also be leveraged to research the impacts of smoke exposure on birth weight and perinatal mortality.

Finally, several leading stove manufacturers are piloting new devices that could help completely change the nature of the consumer proposition, by using the heat of the stove to charge a cell phone or light a bulb (or two or five). If these products can be shown to be reliable enough for the marketplace, they flip the value to the consumer from one of having an improved version of what they already have (a stove) to providing a much desired service, at relatively low cost, for something else they want. That could be a game changer for this field.

11) In your testimony, you note your support for a provision of the Waxman-Markey bill which "calls for providing assistance to foreign countries to reduce, mitigate, and otherwise abate black carbon emissions, and specifically outlines action to provide affordable stoves, fuels or both stoves and fuels to residents of developing countries."
    - How much assistance do you believe will be necessary to make a significant reduction of black carbon?

- What sort of "assistance" would be most effective and how could the United States hold those countries accountable for responsible use of such assistance?
- What are your thoughts on ventures between private businesses and countries that appear to be successful, e.g. Envirofit, which has sold 100,000 stoves in India for about $15 a stove?

One estimate is that as little as a $0.5-$1 billion investment over 10 years could reach 20 percent of the global population – 100 million homes -- while also addressing the core infrastructural issues for the field -- priority applied research, stove standards, global revolving load fund, public awareness, etc. But this should not be considered as just aid given to countries to the tune of: "here is $50M for stoves, Country X – Good luck." Rather it should be a strategic investment that builds critically on private sector solutions, or sustainable and scalable government programs. Merely giving money away here will not succeed. The U.S. does not need to fund the entire amount, but it can lead by partnering with other donor countries, leading foundations, and corporate donors. For example, the UN Foundation has recently announced its intention to launch a Global Alliance on Clean Cook Stoves this September. That is precisely the type of venue that should be funded -- one that is bringing together leadership across the field to develop a robust strategy to create serious and sustainable solutions on a global scale. This effort will build on existing efforts that have been successful at a smaller scale such as EPA's Partnership for Clean Indoor Air, Shell Foundation's Breathing Space program, GTZ's HERA program, and other leading global efforts.

The financial support must address global infrastructure needs of the field (awareness, financing, standards, etc.), answer priority research needs, leverage high-level diplomatic channels, and focus operationally in a targeted set of markets around the world, in close cooperation with leading stove producers.

Envirofit is one stove producer that has entered the market in the past few years, working in close partnership with (and with substantial funding from) the Shell Foundation. That firm has made some very good innovations, and has plans for many more. Testing to date indicates that Envirofit stoves achieve comparable performance as other leading stoves in the marketplace. Envirofit's sales, while impressive, are also not substantially greater than other leaders in the marketplace. Envirofit should be considered simply one of many emerging leaders in this field. Producers that are making high-quality, mass produceable, aspirational stoves at various price points include: GERES (Cambodia and SE Asia), First Energy (India), Philips (India), StoveTec (global), EnviroFit (India and soon Africa), Worldstove (primarily Africa and Haiti), and HELPS (Central America). In sum, we do not just need Envirofit -- we need a hundred Envirofits or more.

12) Your encouragement of offsets for stove replacement programs raise some troubling questions about who would get the offsets – manufacturers of the stoves? The government of the foreign country? The individuals who purchase the stoves?

Successful stove replacement projects require funding. There are many options for funding stove replacement, of which offsets is one. Cook stove replacement is already eligible for carbon financing under the CDM mechanism and other trading schemes because replacing existing cook stoves with more efficient models reduces carbon dioxide and other greenhouse gases. Adding eligibility for black carbon reductions may or may not add much additional economic incentive. EPA should report on this as part of its Congressionally required black carbon study. But, the question of precisely how such an offset program could best be made to work deserves attention. CATF, in our testimony, assumed that offsets for black carbon projects would be handled in the same way with the same safeguards as the Waxman-Markey bill envisioned for offsets in the bill i.e., with strict assurances of baseline and measurement verification, additionality, permanence, leakage, etc. With respect to the parties who would receive the offsets, we assumed that black carbon offsets would be handled similarly to the other eligible offsets in the bill. As we understand that process, the ultimate holder of the offsets would be the entity regulated under the bill's cap. If this process follows the CDM process, we would expect that aggregators will scour the globe looking for opportunities and providing capital for these projects with participation all the way to the customer/user. These middlemen take on most of the financial risk of the enterprise, and accordingly take a good share of the return.

Public financing provides another model that could help facilitate getting more of the value of the offsets to the stove sellers. The advantage to this is that they in turn could either reduce the price of the stove (which in essence then is a pass-through to the purchaser), use the funds to expand manufacturing operations, invest in building a better kiln, or increase marketing operations (all of which will bring better products to more people). So, in the worst-case scenario, the carbon financier takes all the credit, but the stove project still happens. That is not a bad outcome. In the best case, the value of the credit accrues to the local partners and better facilitates sales and growth. That is an even better outcome. To implement this, we would make the following two policy recommendations:

1. Publicly financing efforts to help stove businesses navigate the carbon financing process, so as to reduce the need for middlemen and help all eligible projects take advantage of this financing tool. This is an important, but not enormous investment (likely several millions of dollars to do well).
2. Publicly funding large revolving loan funds to provide the upfront capital for stove projects that meet certain thresholds (e.g., achieve substantial reductions in black carbon in addition to fuel use). This would entail larger investment (tens of millions of dollars).

13) How much funding do you anticipate a 1% allocation of auction value from an economy wide cap-and-trade bill would generate? Are there other options which may offer a stronger alternative to reduce global warming?

The Clean Air Task Force believes significant reductions in U.S. diesel black carbon will require two things: mandates and money. On the money side, CATF recommends that 1 percent of the full allowance value (not the auction proceeds) of the Waxman-Markey or other comparable cap and trade bill for the first ten years be set aside to fund U.S. diesel black carbon reductions. According to EIA's analysis of the Waxman-Markey bill, one percent of the allowance value of the bill for the first ten years would equal $14.6 billion.

In terms of mandates, The U.S. has adopted standards for new engines that the U.S. EPA estimates will reduce particulate matter and black carbon emissions from diesel 90 percent by the year 2030.[6] However, the current economic downturn has brought the rate of fleet turnover to a standstill and, even if the economy comes roaring back, two decades may be too late to avoid triggering dramatic near-term climate impacts. Both to protect the climate and to continue our leadership in reducing health impacts from particulate matter, the U.S. should expeditiously address emissions from our in-use diesel fleet. EPA should exercise its existing regulatory authority under the Clean Air Act and issue a rule requiring all Class 8 trucks built between 1998 and 2006 (after which the new engine standards took effect) to meet emissions standards commensurate with the installation of a filter whenever their engines are rebuilt.[7] Class 8 trucks, which comprise long-haul tractor-trailer trucks, dump trucks, and transit buses, consume nearly 75 percent of the diesel fuel used by on-road trucks in the U.S. and thus are responsible for a commensurate share of black carbon emissions. M.J. Bradley & Associates has estimated that targeting this fleet of approximately 1 million engines for retrofit could achieve the same climate benefits as removing 21 million cars from the road and would save approximately 7500 lives through reduced particulate matter.[8] But, such a rule would cover only 1 million of the 11 million diesel engines in use today. Congress should expand EPA's regulatory authority to require clean up of all of the existing diesel engines that lack diesel particulate filters.

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[6] EPA (2004) *Final Regulatory Analysis: Control of Emissions from Nonroad Diesel Engines*, EPA420-R-04-007; EPA (2000) *Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*, EPA420-R-00-026.

[7] Clean Air Act Sec. 202(a)(3)(D) [42 U.S.C. Sec. 7521(a)(3)(D)].

[8] See CATF Report: *The Carbon Dioxide-Equivalent Benefits of Reducing Black Carbon Emissions from U.S. Class 8 Class 8 Trucks Using Diesel Particulate Filters: A Preliminary Analysis*. http://www.catf.us/projects/diesel/