Black Carbon Emissions from Diesel Sources in Murmansk City and Murmansk Region of Russia

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Outline

- Objectives of the inventory;
- Methodology;
- BC emissions results;
- Uncertainty and extrapolation;
- Conclusions.

Diesel BC Emissions in the Russian Arctic

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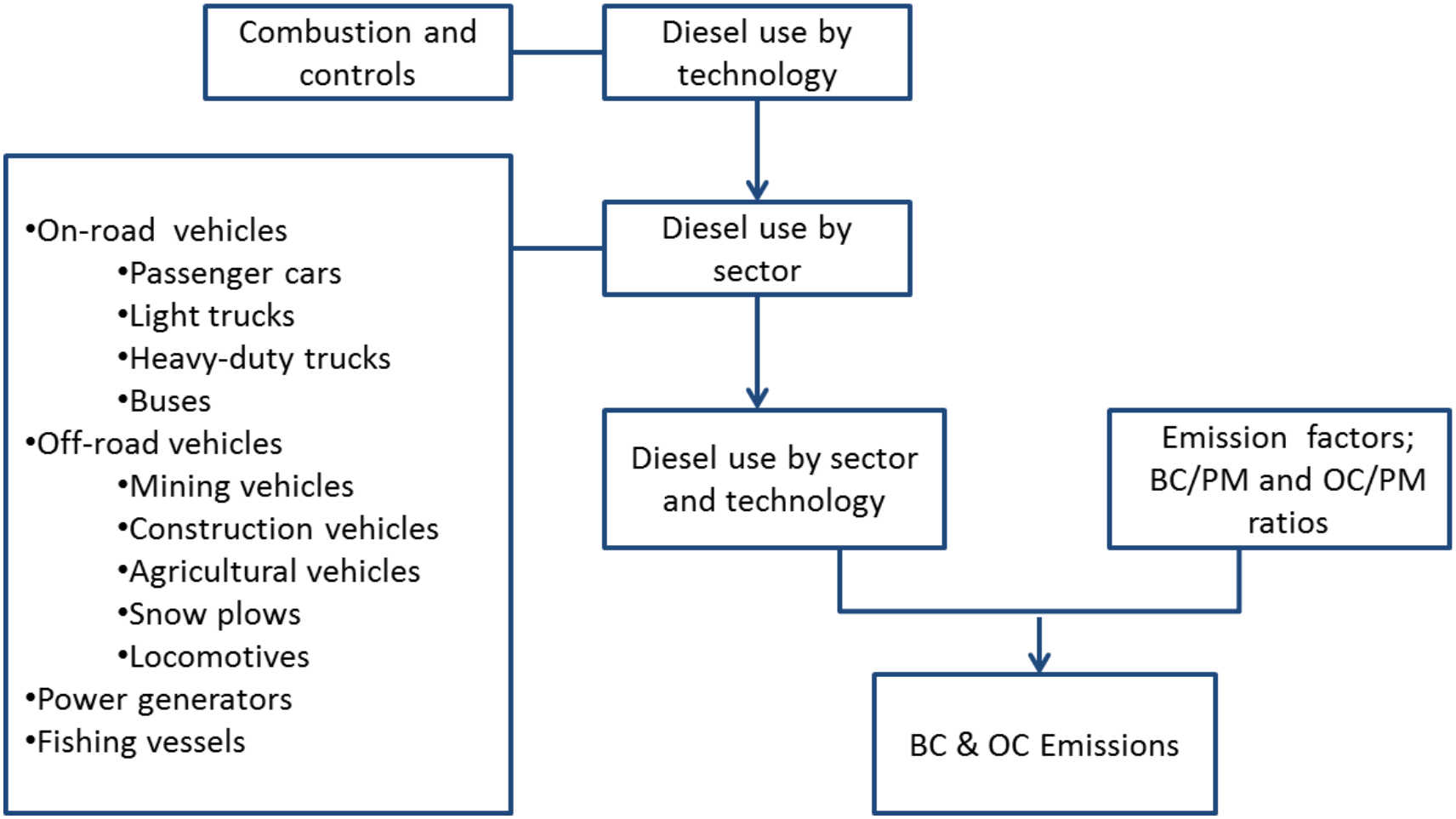
Why it is important?

- Russia makes up a large share of the Arctic;
- Russia has very little data on its black carbon emissions;
- Diesel emissions from within the Russian Arctic contribute substantially to total Arctic concentrations of BC.

Purpose of the inventory:

- Develop bottom-up accounting of BC emissions from diesel sources in Murmansk;
- Enhance understanding of Russian BC emissions.

Inventory Approach



In simple terms:
BC emissions = Activity x Emission Factor x Speciation Ratio for BC

Diesel Consumption in Murmansk Region, 2012: Top-Down and Bottom-Up Approaches

Activity	Diesel use (tons)
On-road transport *	65,100
Mines	139,000
Locomotives	21,200
Construction	4,100
Agriculture	1,300
Diesel generators, including:	8,800
Small generators for commerce and services *	7,100
Off-grid generators *	1,700
Fishing (in Russian territorial waters), including:	3,000
Large and medium vessels *	2,500
Small boats *	500
Total	**242,500**

* - bottom-up calculations

$PM_{2.5}$, BC and OC Emissions in Murmansk Region (tons)

Activity	$PM_{2.5}$	BC	OC
On-road transport	98.9	53.7	36.2
Mines	450.5	279.3	83.8
Locomotives	30.5	22.3	4.5
Construction	15.6	12.0	2.4
Agriculture	5.0	3.9	0.8
Diesel generators	35.2	27.1	5.4
Fishing (in Russian waters)	16.5	5.1	1.0
Total	**652.3**	**403.4**	**134.1**

On-Road Transport

- Data sources on vehicle fleet and activity: registry, parking lot surveys, vehicle inspection station, video surveys, GPS logger data, municipal data.
- Highlights:
  - Share of diesel cars – 12%;
  - The share of vehicles with emissions controls is higher than shown in the registry;
  - Only 40-50% of vehicles are in use in Murmansk City;
  - Euro 0 trucks are the major source of BC emissions.

BC Emissions From On-Road Vehicles in Murmansk City (tons per year)

Ecological Class	BC emissions (tons)
Euro 0	6.4
Euro 1	0.1
Euro 2	1.6
Euro 3	3.1
Euro 4	0.4
Euro 5	0.2
Total	**11.7**

Note: COPERT-IV model with NIIAT emission factors for hot operation stage.

Mining

- There are 4 large open-pit mines in Murmansk Region;
- Fuel consumption:
  - top-bottom approach -139,013 tons;
  - bottom-up approach – 138,554 tons.
- Sources of BC emissions:
  - mining haul trucks;
  - shovels, bulldozers, excavators;
  - supplementary vehicles;
  - drilling equipment

Mining Trucks

- Mining vehicles consume 85% of diesel in open pit mines;
- Belorussian BELAZ trucks dominate the market;
- Most BELAZ trucks are equipped with Cummins engines;
- 88% of Cummins engines are Tier 0;
- Caterpillar and Komatsu trucks might have cleaner engines;
- Total BC emissions by mines – **279.3 tons.**

Other Sources of Black Carbon Emissions

- Off road vehicles do not have emission controls:
  - Construction and road management vehicles, including snow plows;
  - Locomotives;
- Diesel generators;
- Fishing vessels.

Uncertainty

- Emission factors uncertainty;
- Uncertainty in emission controls (Euro 0 – Euro 5; Tier 0 – Tier 2);
- Activity data uncertainty:
  - Top-down approach: fuel use;
  - Bottom-up approach: number of vehicles, average number kilometers travelled; engine power.

Approximate Extrapolation of Black Carbon Emissions from Diesel Sources in Russia (2010)

Sector	Diesel, million tons	BC emissions, tons
On-road transport *	17.3	31,100
Agriculture and forestry**	2.8	8,200
Industry	2.6	5,600
Other sectors	2.9	11,800
Total	**25.6**	**56 700**

* 5,181,200 diesel vehicles registered in 2010.

** ~300,000 tractors in agriculture

Top Policy Conclusions

- Off-road vehicles represent an important opportunity for additional emission reductions; regulation is required to achieve these reductions;
- On-road vehicle emission control regulations have had a strong positive impact;
- Fleet upgrades play an important role in emission reductions;
- Comprehensive government policy is needed, including development of air quality monitoring system.