

# Black Carbon in Russia – Sources and Policy Effects

MEREDYDD EVANS  
NAZAR KHOLOD

JGCRI Integrated Assessment Technical Workshop

October 21, 2014

# 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*	8,800
Fishing (in Russian waters)*	3,000
<b>Total</b>	<b>242,500</b>

\* - bottom-up calculations

# PM<sub>2.5</sub>, BC and OC Emissions in Murmansk Region (tons)

Activity	PM <sub>2.5</sub>	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
<b>Total</b>	<b>652.3</b>	<b>403.4</b>	<b>134.1</b>

- ▶ 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 Region (tons per year)

	Cars	LDV	Trucks	Buses	<b>Total</b>
Euro 0	2.2	1.1	36.2	3.0	42.4
Euro 1	0.0	0.0	0.1	0.0	0.1
Euro 2	1.1	0.5	1.3	0.5	3.3
Euro 3	2.8	1.5	1.8	0.6	6.7
Euro 4	0.3	0.3	0.2	0.0	0.7
Euro 5	0.2	0.1	0.1	0.0	0.4
<b>Total</b>	6.5	3.4	39.7	4.0	53.7

Note: based on NIIAT model

- ▶ There are 4 big 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 the open pit mines
- ▶ BELAZ trucks constitute 70% of the mining fleet
- ▶ Most BELAZ trucks are equipped with Cummins engines
- ▶ 88% of Cummins engines are Tier 0, 12% - Tier 1
- ▶ Caterpillar and Komatsu trucks might have cleaner engines
- ▶ Total BC emissions by mines – **279.3 tons.**

- ▶ The most popular diesel locomotives are Soviet- or Russian-made with a power output of 882 or 1,500 kW
- ▶ Locomotives do not have any emission controls and are old
- ▶ Emission factor for  $PM_{2.5}$ : 1.44 g/kg of fuel
- ▶ BC emissions by locomotives - **22.3 tons** per year.

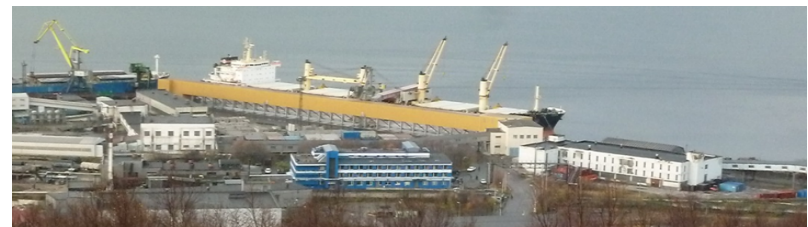






- ▶ Building construction industry used 3,205 tons and road management companies used 865 tons of diesel fuel for off-road vehicles
- ▶ We used EMEP-EEA emission factors:
  - 4.038 g PM<sub>2.5</sub>/kg fuel for construction vehicles without controls
  - 3.551 PM<sub>2.5</sub>/kg fuel for road management equipment without controls
  - 0.967 g/kg fuel for equipment with controls
- ▶ Total BC emissions – **12.0 tons** per year.

- ▶ Fishing companies mainly operate in foreign waters
- ▶ We analyzed emissions from the port to the edge of Russian territorial waters
- ▶ Fishing vessels called into the Murmansk Fishing Port 1,713 times in 2012
- ▶ BC emissions from large and medium fishing vessels are 4,277 kg; BC emissions by small fishing boats are 840 kg per year
- ▶ Total BC emissions – **5.1 tons** per year.



# Diesel Generators

- ▶ Three categories:
  - Generators and heaters that small market shops and service providers operate in settled areas
  - Off-grid generators
  - Back-up generators
- ▶ Total emissions of BC from generators - **26.3 tons** per year.



- ▶ 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 kilometer travelled; engine power.

# Approximate Extrapolation of Black Carbon Emissions from Diesel Sources in Russia

Sector	Fuel, 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

\* - There were 5,181,200 diesel vehicles in Russia in 2010. We used the NIIAT emission factors and bottom-up fuel calculations.

Total BC emissions in Russia from all diesel sources in 2010 estimated to be **56,700 metric tons**.

# 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.