



How do different sources contribute to population exposure to key air pollutants in Bulgaria

*DIMA TSANOVA
DEPARTMENT OF PUBLIC HEALTH SCIENCES,
FACULTY OF PUBLIC HEALTH,
MEDICAL UNIVERSITY - PLEVEN, BULGARIA*

09.06.2021

Introduction

2

- Air pollution is a global threat leading to large impacts on human health and ecosystems.
- Air pollution was the 4th leading risk factor for early death in 2019, surpassed only by high blood pressure, tobacco use, and poor diet.
- Heart diseases and stroke are the most common reasons for premature death attributable to air pollution, followed by lung diseases and lung cancer.

Introduction

3

- In Europe air quality remains poor in many areas, despite reductions in emissions and ambient concentrations.
- Europe's air quality has improved over time but, at the same time, it continues to give cause for severe concern: the European Environment Agency (EEA) estimates that more than 400 000 premature deaths occur each year in the EU due to air pollution and poor air quality.

Pollutants

- The three pollutants considered most harmful by the WHO and for which the evidence of health effects is strongest:
 - particulate matter with a diameter below $2.5\ \mu\text{m}$ (PM)
 - nitrogen dioxide (NO_2)
 - ground-level ozone (O_3)
- Air pollution is a complex mix of several pollutants, so the effects attributed to one pollutant may be partly caused by some others.
- Health experts consider the pollutants identified above to be proxies for the whole mixture.
- PM has been shown to be a robust indicator of the risk associated with exposure to PM from diverse sources and in different environments.

Air pollutants

5

- Primary pollutants are directly emitted to the atmosphere, whereas secondary pollutants are formed in the atmosphere from precursor pollutants through chemical reactions and microphysical processes.
- Air pollutants may have a natural, anthropogenic or mixed origin, depending on their sources or the sources of their precursors.

Primary air pollutants

6

- particulate matter (PM)
- black carbon (BC)
- sulphur oxides (SO_X)
- nitrogen oxides (NO_X) (which includes both nitrogen monoxide, NO, and nitrogen dioxide, NO₂)
- ammonia (NH₃)
- carbon monoxide (CO)
- methane (CH₄)
- non-methane volatile organic compounds (NMVOCs), including benzene (C₆H₆) (7), certain metals and polycyclic aromatic hydrocarbons (PAHs) including benzo[a]pyrene (BaP).

Secondary air pollutants

7

- PM (formed in the atmosphere),
 - ozone (O_3),
 - NO_2 and several oxidised volatile organic compounds (VOCs).
-
- Key precursor gases for secondary PM are sulphur dioxide (SO_2), NO_x , NH_3 , and VOCs.
 - Gases SO_2 , NO_x and NH_3 react in the atmosphere to form particulate sulphate (SO_4^{2-}), nitrate (NO_3^-) and ammonium (NH_4^+) compounds. These compounds form new particles in the air or condense onto pre-existing ones to form secondary inorganic PM.
 - Certain NMVOCs are oxidised to form less volatile compounds, which form secondary organic aerosols.
 - Ground-level (tropospheric) O_3 is not directly emitted into the atmosphere. Instead, it is formed from chemical reactions in the presence of sunlight, following emissions of precursor gases, mainly NO_x , NMVOCs, CO and CH_4 .

**main types of
air pollution
sources:**

- mobile sources – cars, buses, planes, trucks, and trains
- stationary sources – power plants, oil refineries, industrial facilities, and factories
- area sources – agricultural areas, cities, and wood burning fireplaces
- natural sources – wind-blown dust, wildfires, and volcanoes

Bulgaria

9

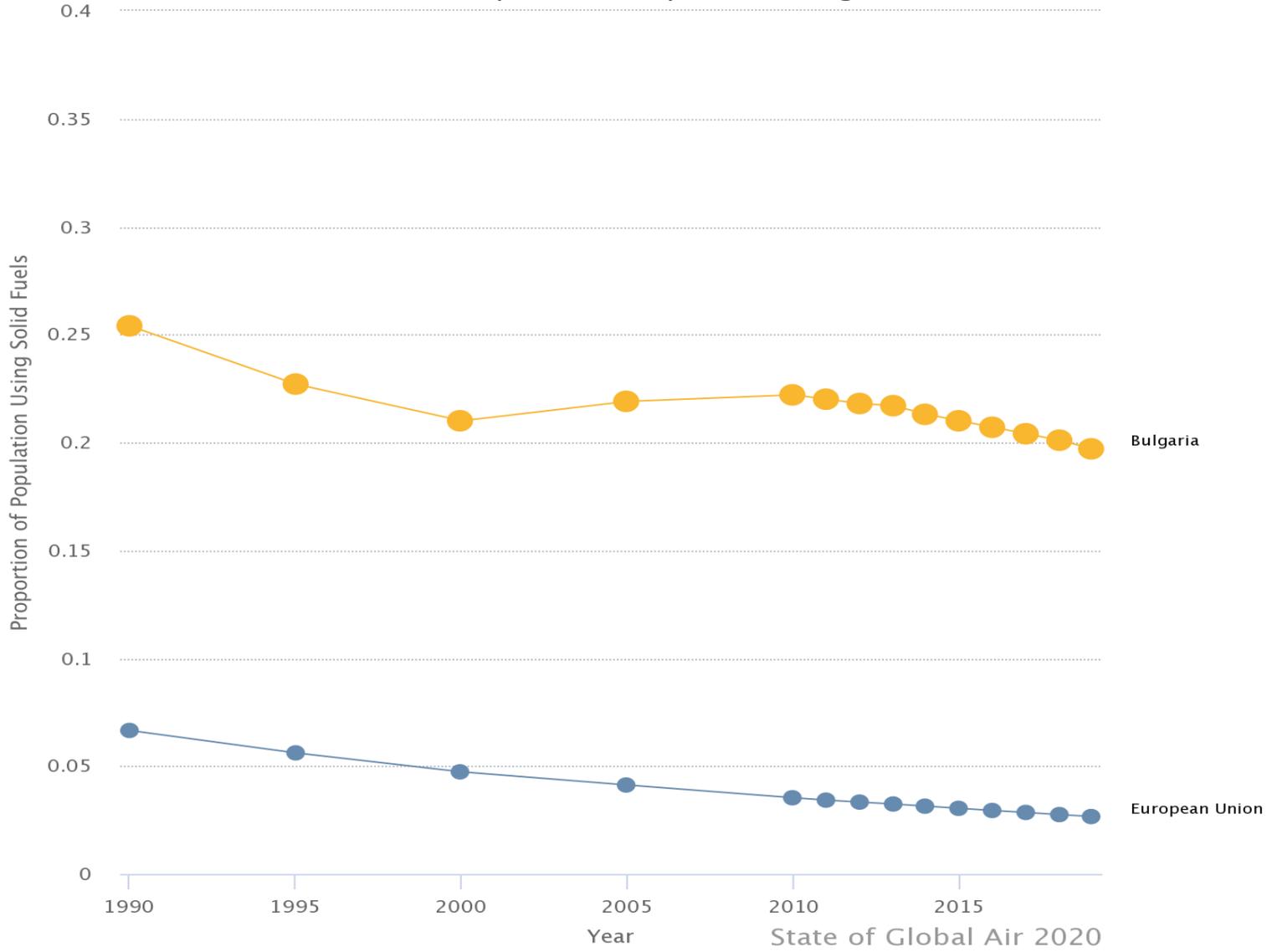
- Bulgaria has a history of Soviet-era industrialization with scant attention paid to environmental issues. Given its standing as one of Europe's poorer nations, it appears to have made limited progress in cleaning up our air.
- A 2011 report from the United Nations found that Bulgaria, along with Armenia and Romania, “lead the world in deaths from outdoor air pollution.” That said, the particulate levels reported in Bulgaria fall well short of the alarming levels.

Bulgaria

10

- For Bulgaria, air quality was one of the priorities for our EU presidency.
- The country's top priority is to reduce air pollution from low-quality domestic heating. Over half of all Bulgarian households use solid fuels (coal, briquettes and wood) to heat their homes.
- In cities like Sofia, this is the main cause of particulate matter (PM₁₀ and PM_{2.5})

Proportion of Population Using Solid Fuels

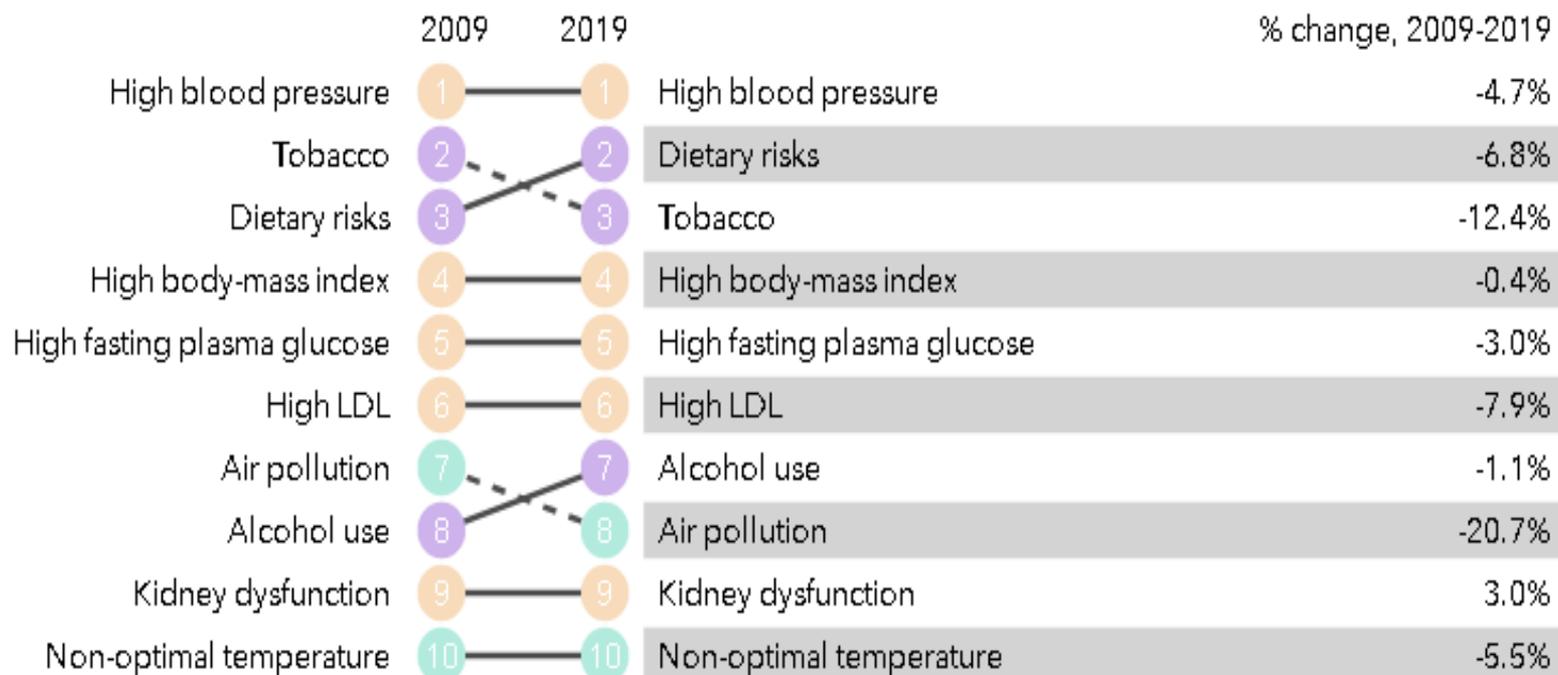


State of Global Air 2020

Top 10 risks contributing to total number of DALYs in 2019 and percent change 2009–2019, all ages combined

12

- Metabolic risks
- Environmental/occupational risks
- Behavioral risks



Years of life lost (YLL) attributable to PM_{2.5}, NO₂ and O₃

13

	PM _{2.5}	NO ₂	O ₃
Kosovo	2100	14	51
Serbia	1919	209	41
Bulgaria	1858	151	42
EU-28	800	100	30
Total	900	100	30

Years of life lost (YLL) attributable to PM_{2.5}, NO₂ and O₃
exposure in Bulgaria and other European countries, and the EU-28, 2016

The percentage of urban population exposed to concentration above EU standards in Bulgaria

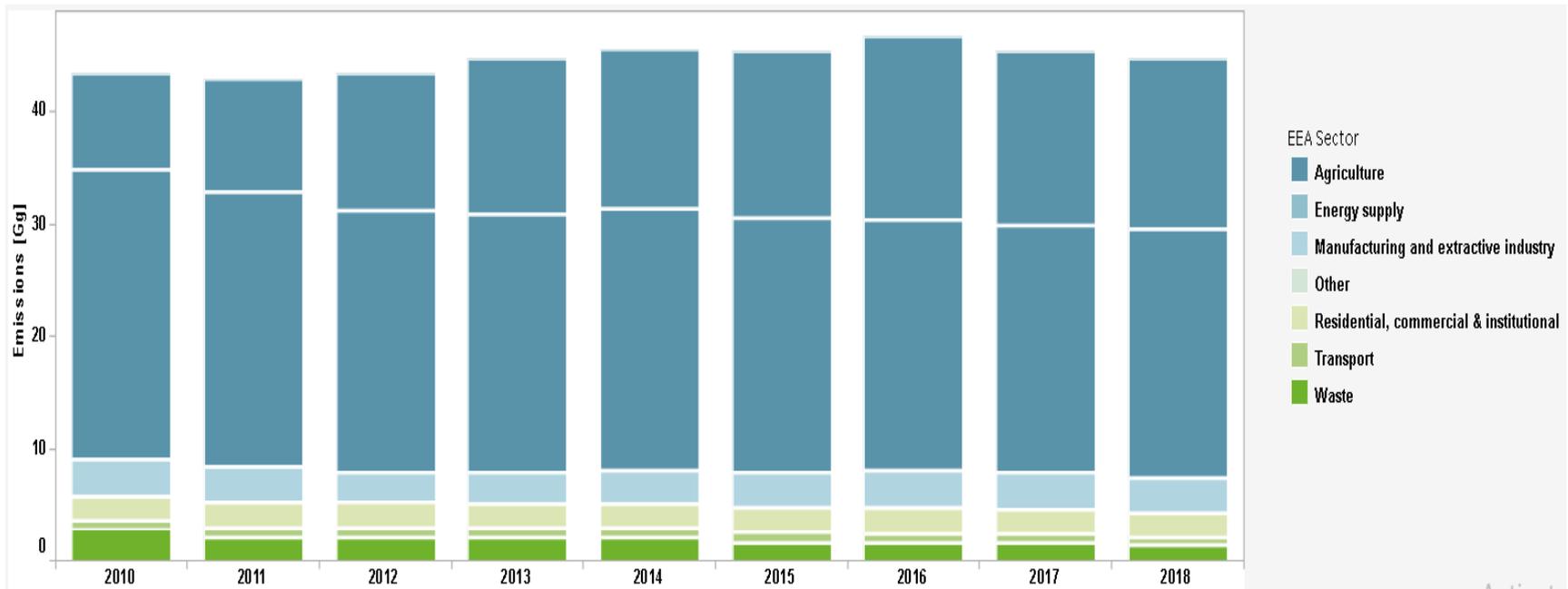
14

		2014		2015	2016	2017	2018
NO2	annual mean	0.0		0.2	6.9	0.5	0.0
O3	percentile 93.15	0.0		0.0	0.0	0.0	0.0
BaP	annual mean	25.4		34.7	33.7	28.4	26.5
PM2.5	annual mean	77.0		25.7	0.0	69.0	7.2
PM10	percentile 90.41	96.9		78.9	90.7	75.7	65.4

NH₃ – sources, % of total

15

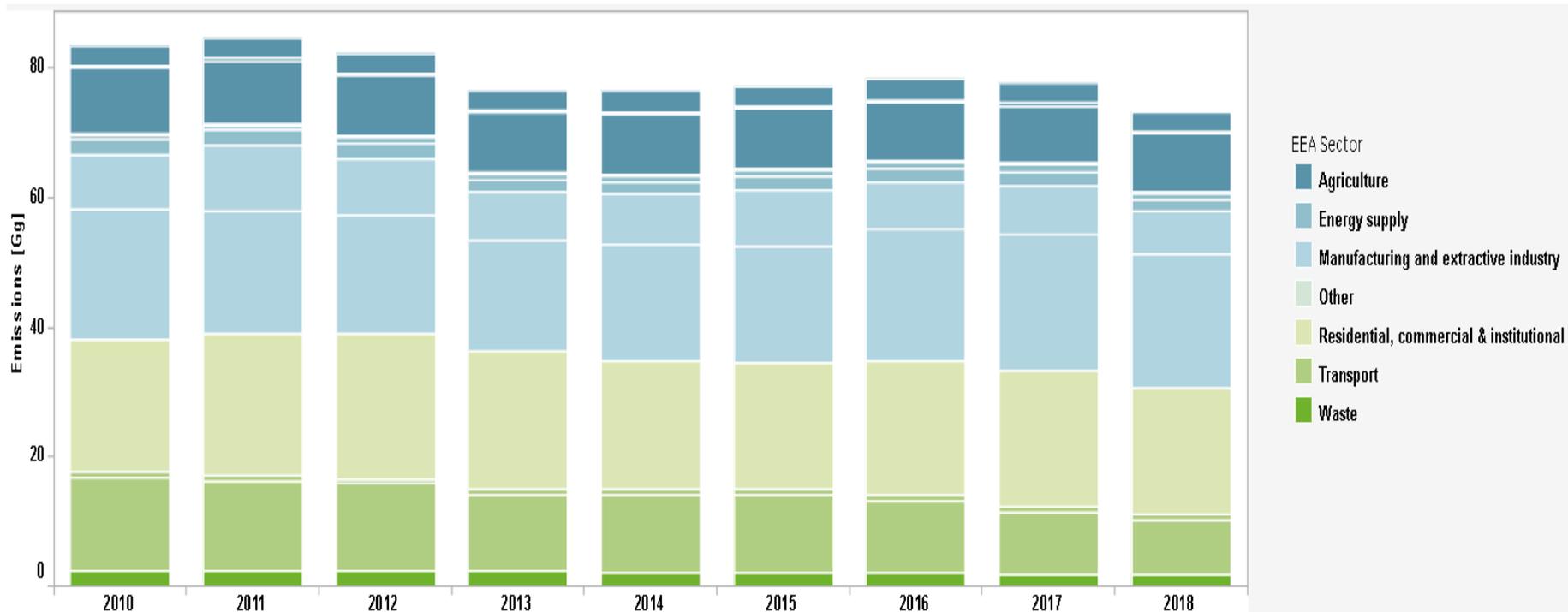
Agriculture	Energy supply	Manufacturing and extractive industry	Residential, commercial & institutional	Transport	Waste
83.21	-	7.09	4.72	1.71	3.26



NMVOOC – sources, % of total

16

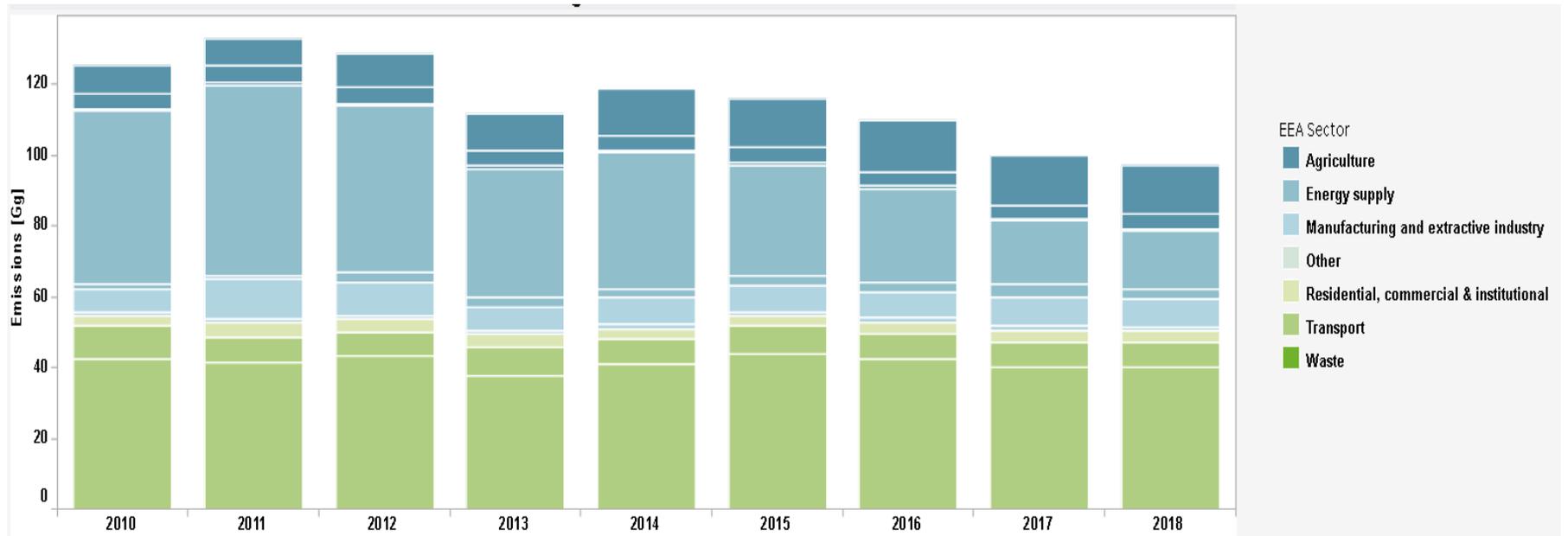
Agriculture	Energy supply	Manufacturing and extractive industry	Residential, commercial & institutional	Transport	Waste
16.84	4.37	36.91	26.57	12.82	2.49



NO_x – sources, % of total

17

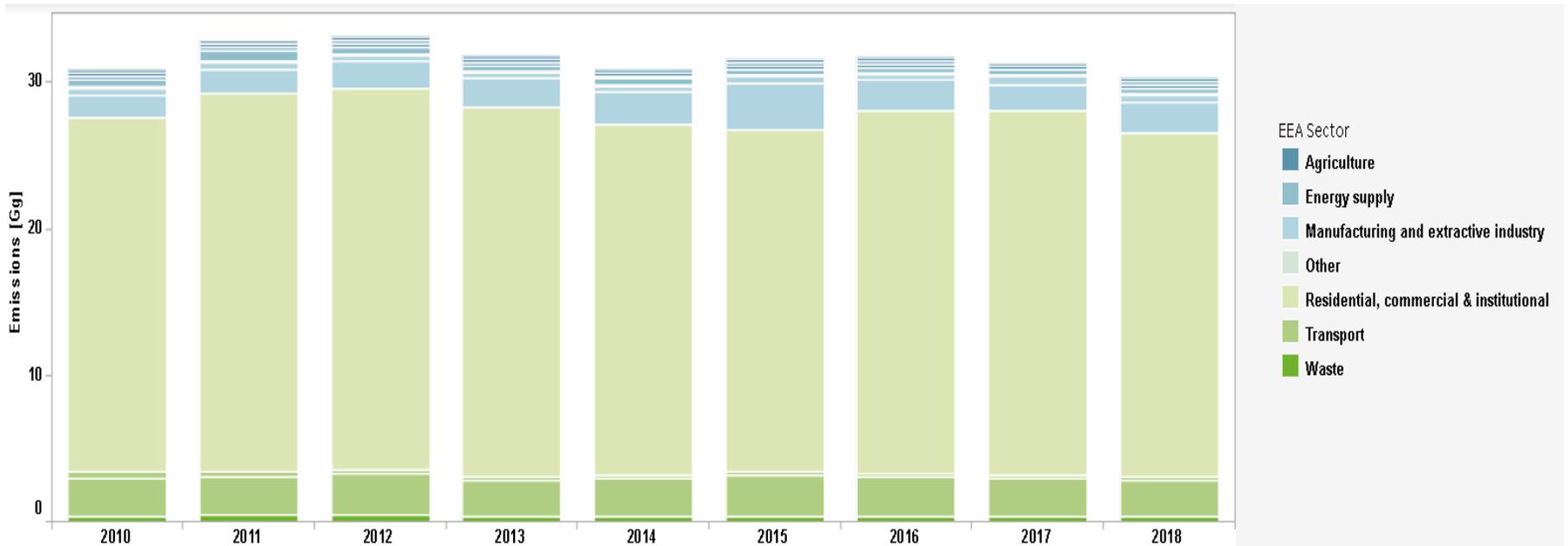
Agriculture	Energy supply	Manufacturing and extractive industry	Residential, commercial & institutional	Transport	Waste
19.05	19.71	9.46	3.03	48.74	-



PM_{2.5} – sources, % of total

18

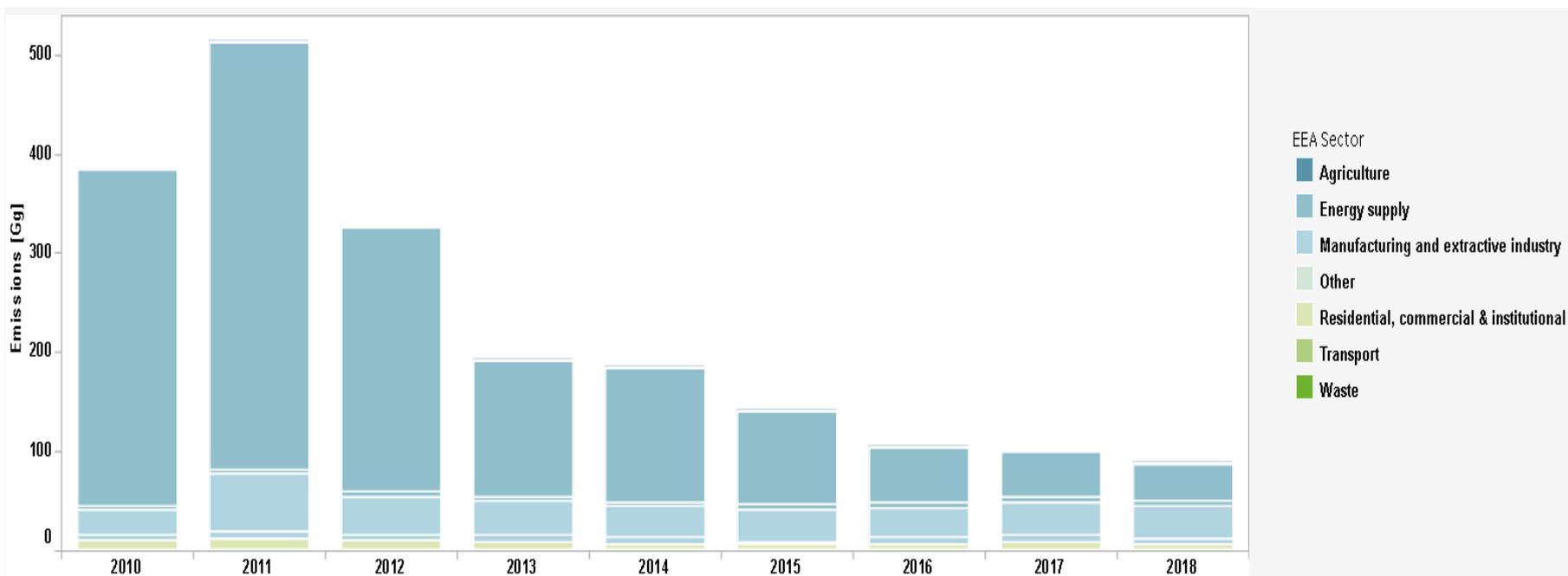
Agriculture	Energy supply	Manufacturing and extractive industry	Residential, commercial & institutional	Transport	Waste
2.18	1.21	9.07	77.3	9.05	1.19

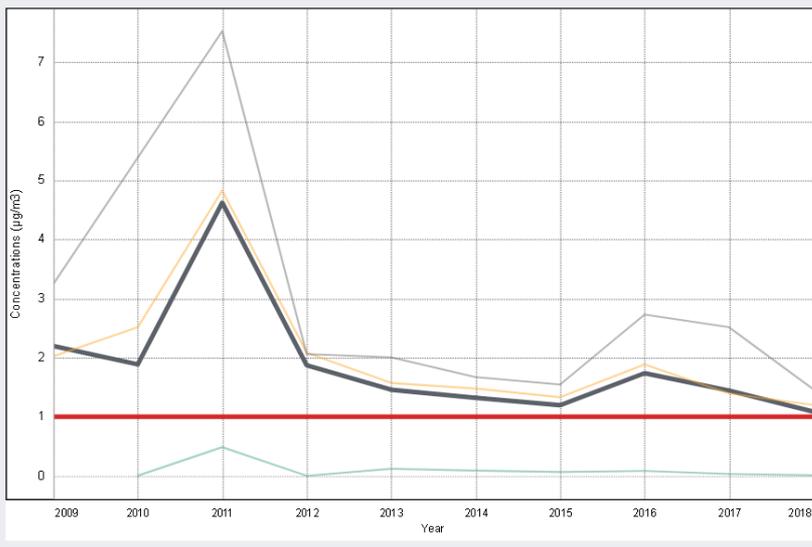


SO₂ – sources, % of total

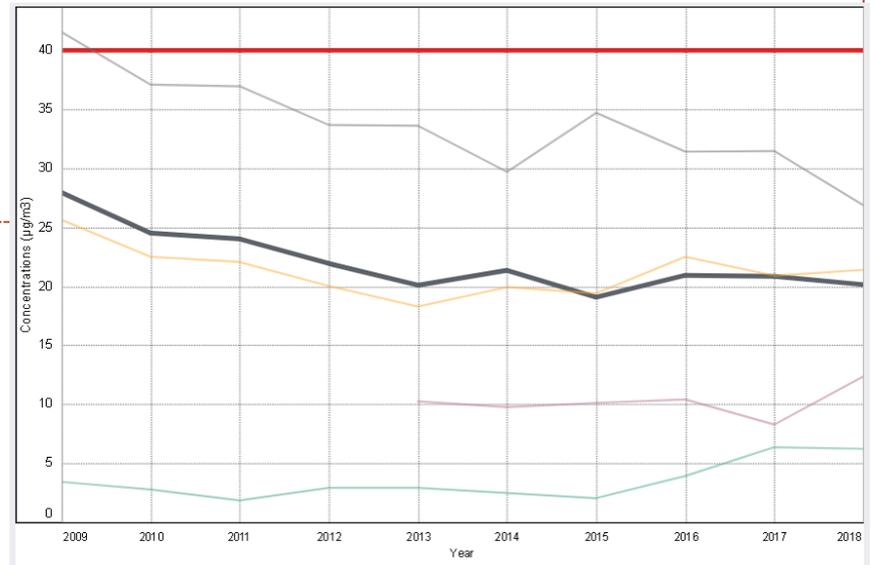
19

Agriculture	Energy supply	Manufacturing and extractive industry	Residential, commercial & institutional	Transport	Waste
0.27	48.45	43.78	5.55	-	-

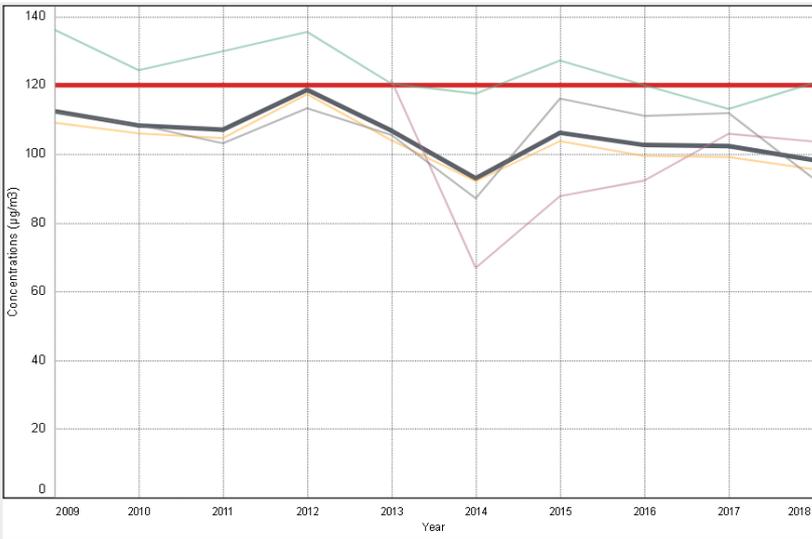




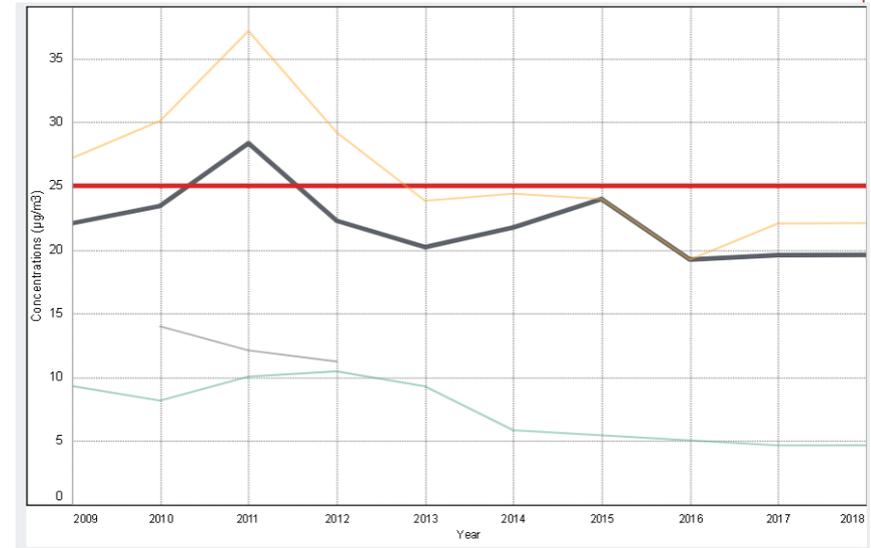
BaP



NO₂



O₃



PM_{2.5}



Conclusions

- Agriculture must not be neglected in the battle for clean air. Energy and transport are the biggest cause of poor air quality in cities but the agricultural sector is also an important source of particulate matter as ammonia contributes to the formation of (secondary) particulates.
- Holistic solutions involving technological developments, structural changes and behavioural changes are also needed, together with an integrated multidisciplinary approach.
- Efforts to achieve most of the Sustainable Development Goals (SDGs) (2) are linked directly or indirectly to mitigating air emissions and changes in atmospheric composition

Conclusions

22

- Household air pollution is most closely linked to socioeconomic and demographic development. Improvements in sociodemographic indicators, coupled with major investments in clean energy for cooking have driven significant declines in exposure to global household air pollution and its associated burden of disease.
- Reducing the burden of disease from air pollution is an important goal for Bulgaria to achieve.
- Communication of these patterns and trends forces recognition of the magnitude of the problem and whether or not we're making progress toward cleaner air and healthier communities.

References

- <http://eea.government.bg/bg/soer/2018/air/emisii-na-vredni-veshtestva-vav-vazduha>
- Health Effects Institute. 2020. State of Global Air 2020. Data source: Global Burden of Disease Study 2019. IHME, 2020.
- <https://www.eea.europa.eu/data-and-maps/indicators/main-anthropogenic-air-pollutant-emissions/assessment-6>
- <https://www.eea.europa.eu/themes/air/country-fact-sheets/2020-country-fact-sheets/bulgaria>
- <https://www.eea.europa.eu/themes/air/air-pollution-sources-1/air-pollution-sources>
- https://env-health.org/IMG/pdf/heal_briefing_air_bulgaria_bgversion.pdf
- GBD studies, <http://www.healthdata.org/results/country-profiles>

Thank you



Contact:
Dima Tsanova
d_krumova@abv.bg