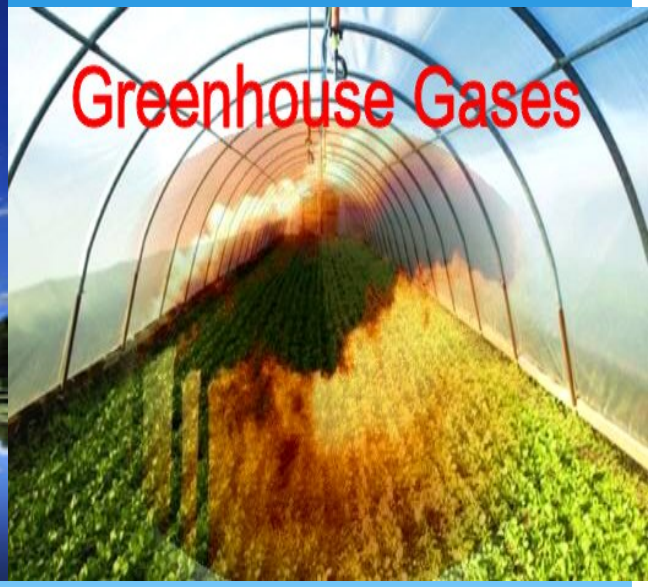
Assessment of Emissions and emissions reduction in Azerbaijan's Road Transport



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July 31,Dallas,Texas

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Outline

- The country Background;
- Current status of road transport sector in country;
- The number of vehicles and air pollution;
- Emissions by road transport;
- Emissions reduction targets to 2030;
- Fleet Renewal;
- Prompting the wider use of next generation vehicles;
- Assessment of car pollutions by COPERT-4 software program;
- The research work
- The calculation results of COPERT-4 ;
- The map of pollutants spreading on the streets;
- Calculating data;
- Results.

The country Background

Oil and gas extractive industry, electricity production, chemical refining, agriculture and the service sector contribute to the base of economy output;

The GDP increase grows is about 1,0 percent per year;

İncome with GDP(gross domestic product) per capita of 4780,0 USA $ in 2018;

There are 10,0 mln residents in Azerbaijan and increase rate is 1,3 % per year;

The Ministry of Ecology and Natural Resources (MENR) is responsible for ecology and climate policy of Azerbaijan;

The number of vehicles is 1,34 mln.

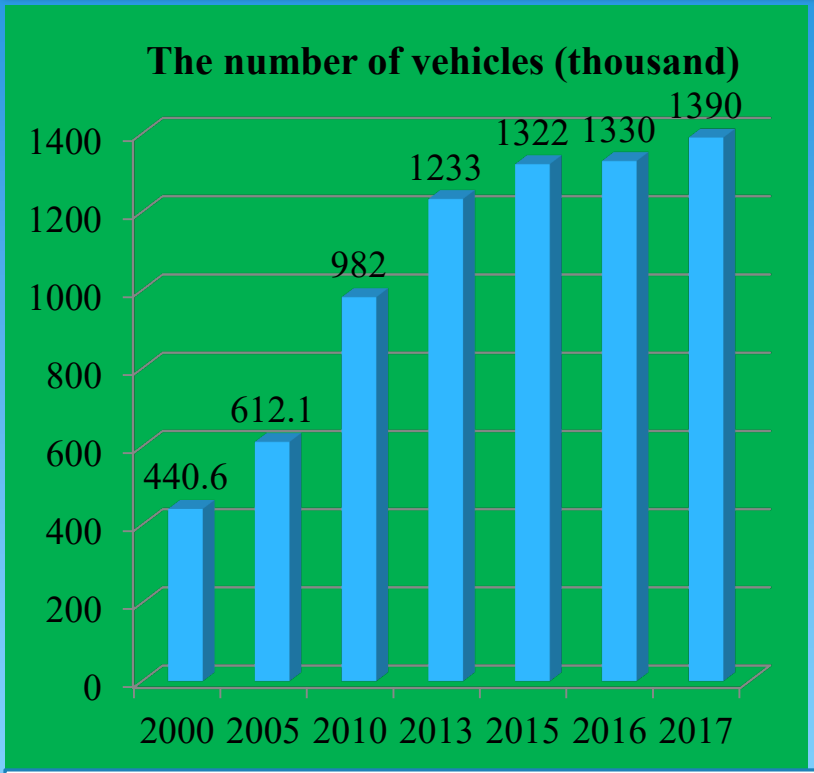
Motor vehicles per 1000 persons -138;

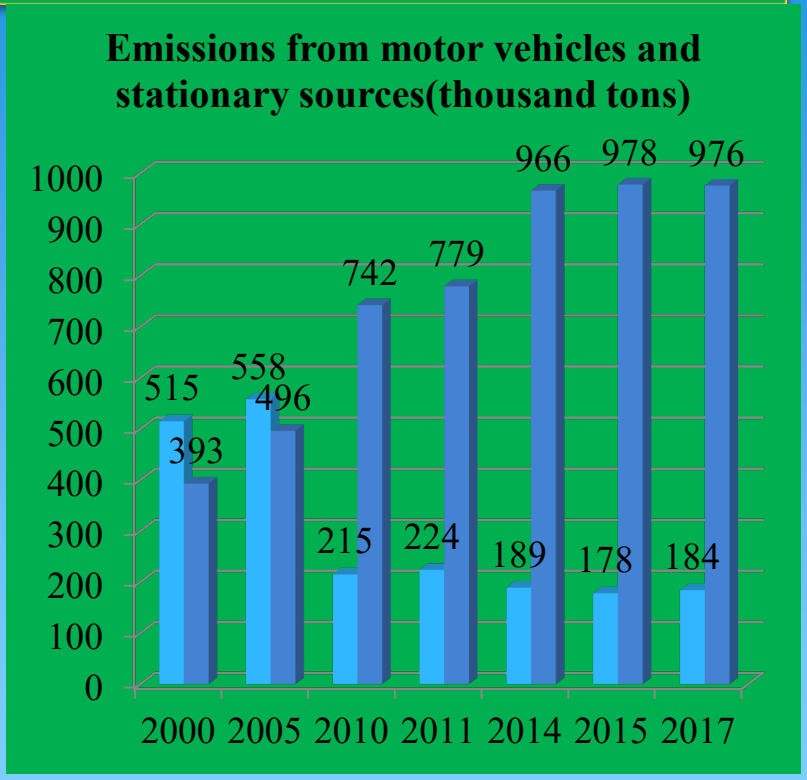
Net emission for the country covers 77.3% of 1990 base year.

Azerbaijan aims to cut Green Hause Gas Emission (GHG) in 35 % by 2030 in comparison with 1990 level

Prepared National Climate Change Policy.

The number of vehicles and air pollution, 2000-2017

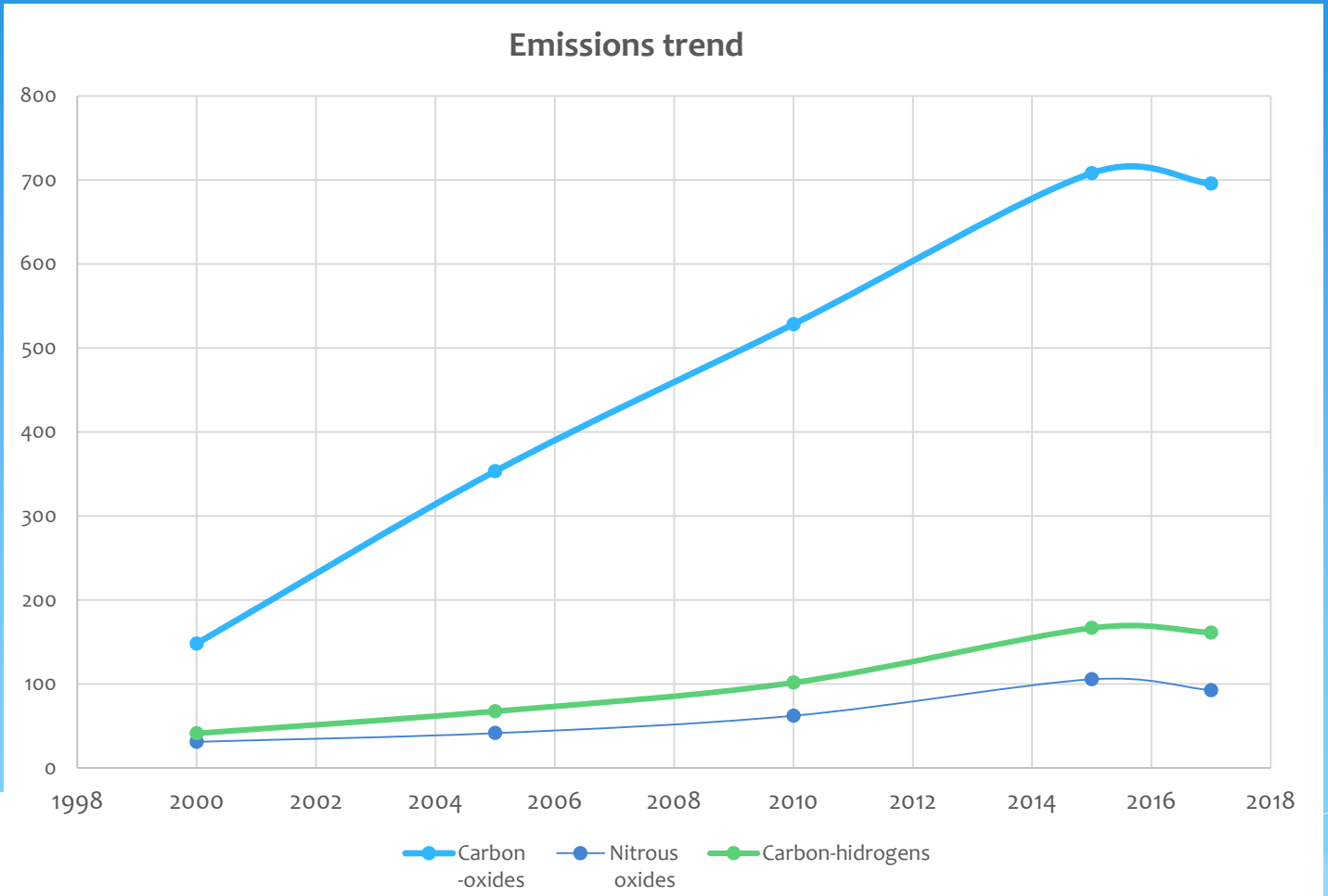




According to the development of oil industry, number of vehicles have been increased in Azerbaijan. Thus, the number of registered vehicles was just 440 thousand in 2000, it reached to 1.42 million number in 2017 and continue to grow up by 30-50 (6-8%) thousand per year. From 2010 (982,0) to 2015 year increasing the number of vehicles is 34 %.

Official reports shows that annual fuel consumption – gasoline- 1.36 mln ton , diesel fuel 940 thousand ton and LPG (Liquefied Petroleum Gas) 25.1 thousand ton .

Emissions by road transport



Emissions reduction targets to 2030

Reduction will be achieved:

- **Vehicle FE improvement wider use of next generation vehicles;**
- **Eco driving;**
- **Improvement traffic flow;**
- **Fuel diversity;**

Total 25% reduction by fiscal year 2030 compared to fiscal 2015 .

year	2000	2005	2010	2015	2017	Reduction (%)	2030
Carbon-oxides(thousand ton)	148,2	353,7	528,3	708,1	695,6	-1,8	-30%
Nitrous-oxide	30,3	41,6	62,3	105,6	92,6	-12,3	-20%
Carbon-hydrogens	41,3	67,6	101,7	166,7	161,3	-0,3	-22%
Total	392,7	496,4	742	977,7	976,4	-0,12	25%

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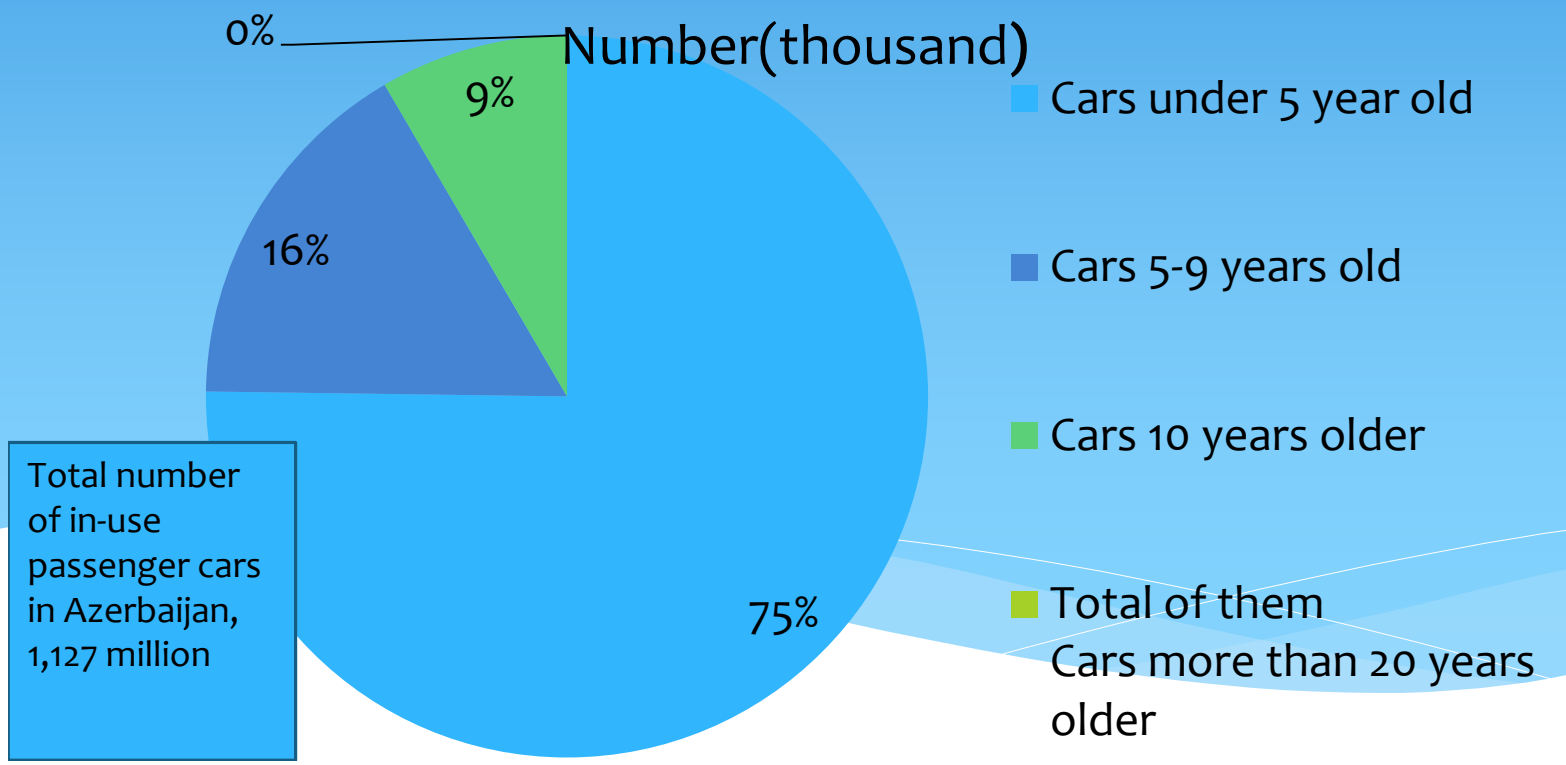
Fleet Renewal

The fleet turnover rate(i.e., replacement with new cars) stands less than 10 % of the total fleet.

Government support (through tax incentives and vehicle purchasing subsidies) is necessary to promote, in particular, increased purchases of next generation vehicles(EVs, PHVs, etc.)



Total number of in-use passenger cars in Azerbaijan, 1,127 million

Prompting the wider use of next generation vehicles(Gov. Targets)

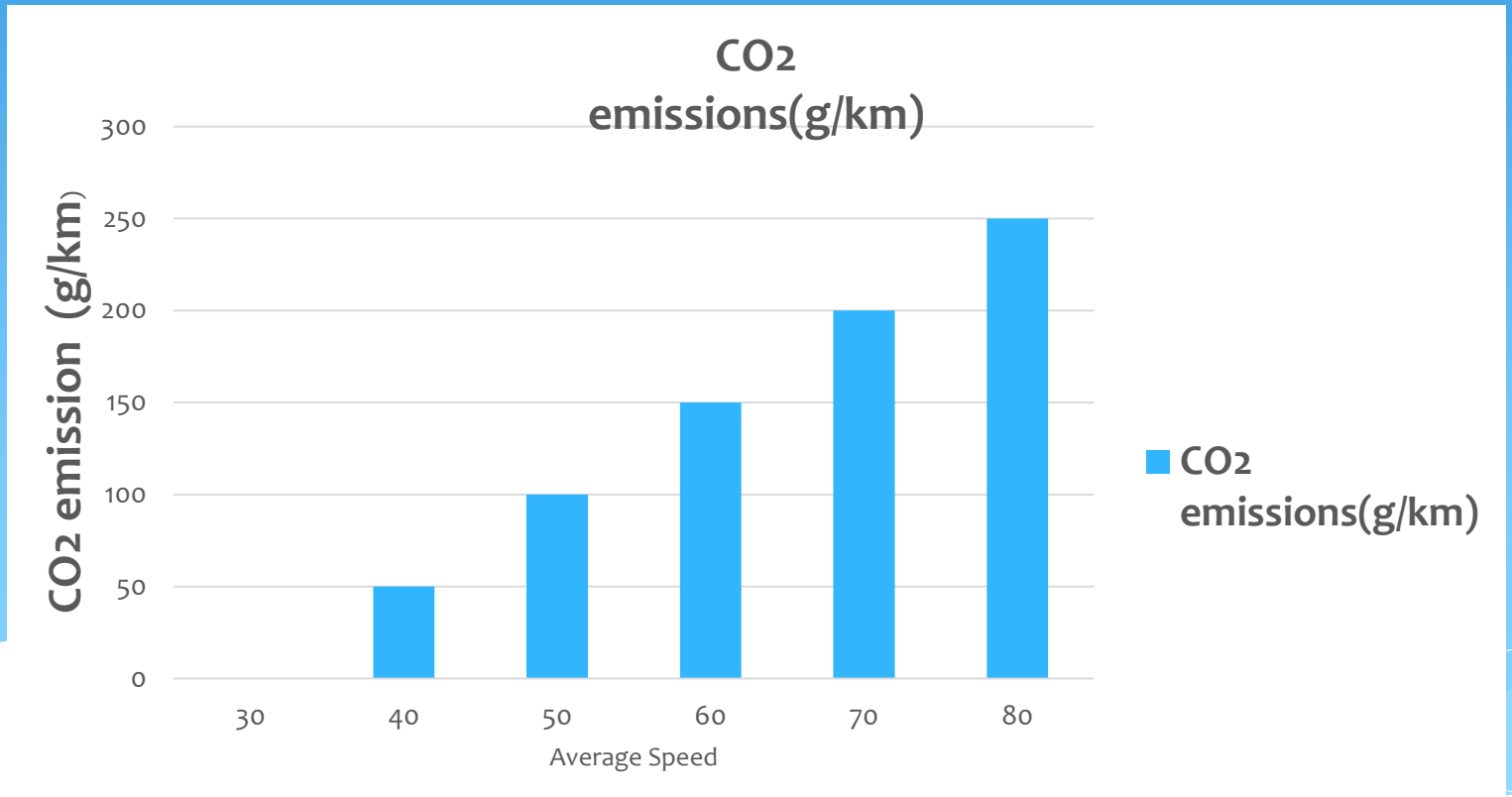
- The Azerbaijan government has established the targets shown below for next generation vehicles shares in new car challenging by 2030.
- Achieving the targets for EVs and PHVs in especially challenging.
- This approach requires the parallel implementation of measures in four pilar areas as shown here, Integrated approach:

Fuel efficiency vehicles: Improvement of fuel economy; Development of next generation vehicles	More efficient vehicles use: Adopting eco driving practices; Improving efficiency in truck use	Improved traffic flow: Wider use of electronic toll collection(ETC) Expanded use of advanced ITS	Diversified fuel supply: Development of advanced EVs,HFCVs

	2017	2030 (Target)
Conventional vehicles(gasoline powered vehicle)(%)	90,0	65%
Next generation vehicles	3,2%	12,5%
Hybrid vehicles	1,2%	15,0 %
Diesel vehicles	10%	4%

Improving Traffic Flow

- Increased vehicles speed, as shown in the graph below, reduces vehicles CO2 emissions. Measure to improve traffic flow are needed in order to curb emissions in road transport.



Emissions calculating methodology

Methodology

1.

$$E = e \times a$$

Emission factor

Emission factors from
MEET / COST methodology

- Different vehicle technologies (engine capacity, vehicle mass, emission reduction technology)
- Average speed approach
- Future technologies
- Pollutants: CO, CO_2,NO_x, VOC, PM10, SO_2

Link to transportation model

- *Cold start emission with high spatial resolution*

Link to GIS

- *High spatial resolution*
- *Spatial analysis of the emission data*

Different aggregation levels for vehicle classification

- *Adopted to the data available*

Assessment of car pollutions by COPERT-4 software program

COPERT-4 is a software tool used for the calculation of air pollutant and greenhouse gas emissions from road transport. The European Environment Agency (EEA) coordinates the development of the software.

COPERT 4 software evaluation program has been applied to calculate Carbon-dioxide (CO2),nitrous oxides(N2O) and methane (CH4) which is one of main source of Global Warming and Climate Changes.

The methodology has been based on IPCC/CORINAIR air pollutant emissions inventory guidebook. The key results of the study show that calculating vehicles emission using the COPERT-4 methodology can improve the estimation methods and could help to find out the pollution level, especially in the cities.

This COPERT-4 software methodology still new for this region because all the reports and calculations had been conducted by applying old methods Within COPERT-4 software emissions are estimated by different engine regimes, different driving regimes, different speeds, and road infrastructure.

The research work

Generally, native Oil and Gas refinery plants was capable provide fuel for country until 2014, while government was forced to import additional 200 thousand ton gasoline from the beginning of 2014 due to increasing number of vehicles and this volume goes upward.

Consumption of fuel by vehicles 89% of petrol and10% of diesel and 1% is LPG. Bad technical condition, not sufficient infrastructure, quality of petrol, peak of vehicles on city streets one of many causes to increase air pollution.

The governmental institutions use the post soviet methods of N.Tishenko (Метод расчета и методологиям .Н.Ф. Тишенко «Охрана атмосферного воздуха » Москва-1991) for evaluation the emissions by vehicles. The methodology has possibilities only to estimate CO and CH while was effectively for soviet and Russian production vehicles. The methodology isn't appropriate to estimate of emissions by new EU production(USA, Japan, South Korea) vehicles.

The method based on fuel consumption and average emission factors on the guidelines of İPCC. Methodology require the collection of all the considered activity data by using the respective guidelines, calculate the total emissions from each source and pollutants of interest. Currently, gradual growth at fuel consumption is irrational for economical and air quality aspects

The research work

The COPERT methodology is based on an transport emission inventory included on EMEP/EEA guidebooks. It considers different typologies of motor vehicles such as passenger cars, light duty vehicles, heavy duty vehicles, buses, mopeds and motorcycles and uses emission factors to estimate pollutant emissions (CO, NOx, VOC, PM, SO2,heavy metals) and greenhouse gases (CO2, N2O, CH4).

The methodology is based on vehicles activity and uses an inputs average speed, distribution of time under urban, rural and highway environments, vehicle typology and engine displacement.

The vehicles data was taken by State Statistical Committee of Azerbaijan (the number and type of vehicles, fuel consumption), the annual hydrological data was taken by MENR. The other data (the average age of vehicles, average fleet mileage, the volume of engines, speed of vehicles on rural, city and highways,) was investigated by us according to the sciences data.

The calculation results of COPERT-4

N/n	Name of emission	Urban roads (thousand tons)	Local roads (thousand tons)	Main roads (thousand tons)	Total (thousand tons)
1	**Carbon monooxide-CO**	183,21	119,9	105,01	408,12
2	**VOCs**	21,99	12,3	11,16	44,57
3	**Non methane organic compounds (NMVOC) emissions**	10,7	11,78	19,74	42,21
4	**Nitrous oxides-NOx**	34,29	20,58	14,05	68.9
5	**Nitrous monoxide-NO**	32,48	19,4	13,218	65,101
6	**Nitrous dioxide-NO_2**	3,81	1,16	0,83	3,81
7	**Diazot-monooksid N_2O**	0,089	0,061	0.11	0,256
8	**PM 2,5**	0,321	0,282	0,245	0,849
9	**FC(Fuel Consuption)**	7939,8	846,7	1180,5	2820,90
10	**PM 10**	0,335	0,381	0,382	1, 099
11	**PM exhaust**	0,149	0,168	0,227	0,544
12	**CH_4 -Methane**	1,35	0,52	0,47	2.35
13	**CO_2 -Carbon-dioxide**	2492,4	2656,8	3706,8	8856,1
	Total	**288,421**	**187,062**	**166,654**	**642,018**

Fuel consumption

Figure 1 shows the fuel consumption of vehicles evaluated by COPERT 4. According to the total results of COPERT-4, 2,82 mln ton fuel have been consumption by all type of vehicles while 82.2% of fuel consumed by light cars, the share of heavy duty trucks is 2,9 %, the share of buses is 13,8 % and 1,1% the other vehicles such as mopeds, motorcycles. The distribution of fuel consumption on the highways -41,85% , the urban streets 28,16% and 30,0% on the rural ways.

The data of fuel consumption including to the COPERT-4 program was less than the estimation results. The differences of fuel consumption between official sources and results of COPERT-4 is explains so that passing transition cargo vehicles on east side from Georgia-Azerbaijan-Russian) and south side (Iran - Azerbaijan-Russian,) while use the fuel in their home countries.

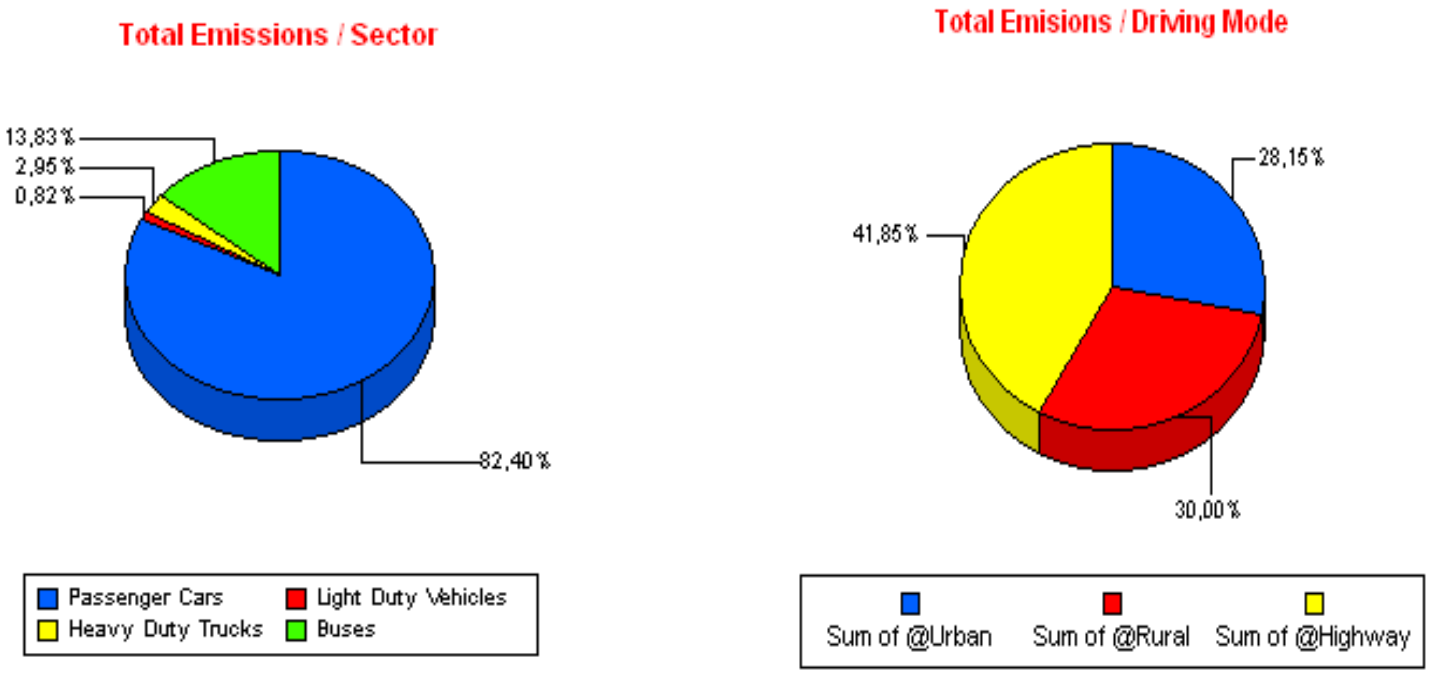


Figure 1. The data of fuel consumption sharing among vehicles types.

Carbon-dioxide-CO2

- Figure 2 shows the results of carbon-dioxide CO2 emissions which is one of main GHG evaluated by COPERT 4. The amount of CO2 emission is about 8,85 mln ton per year. According to the results, 59,9 % of carbon-dioxide CO2 by passenger cars, the share of buses is 28,8 % , the share of heavy duty trucks is 7,40 %, light duty commercial trucks is 3,0 %, and other parts of carbon –dioxide emissions by vehicles such as mopeds, motorcycles.
- The share of CO2 emissions on the highways -57,7%, the urban streets 22,9% and 20,1% on the rural ways.

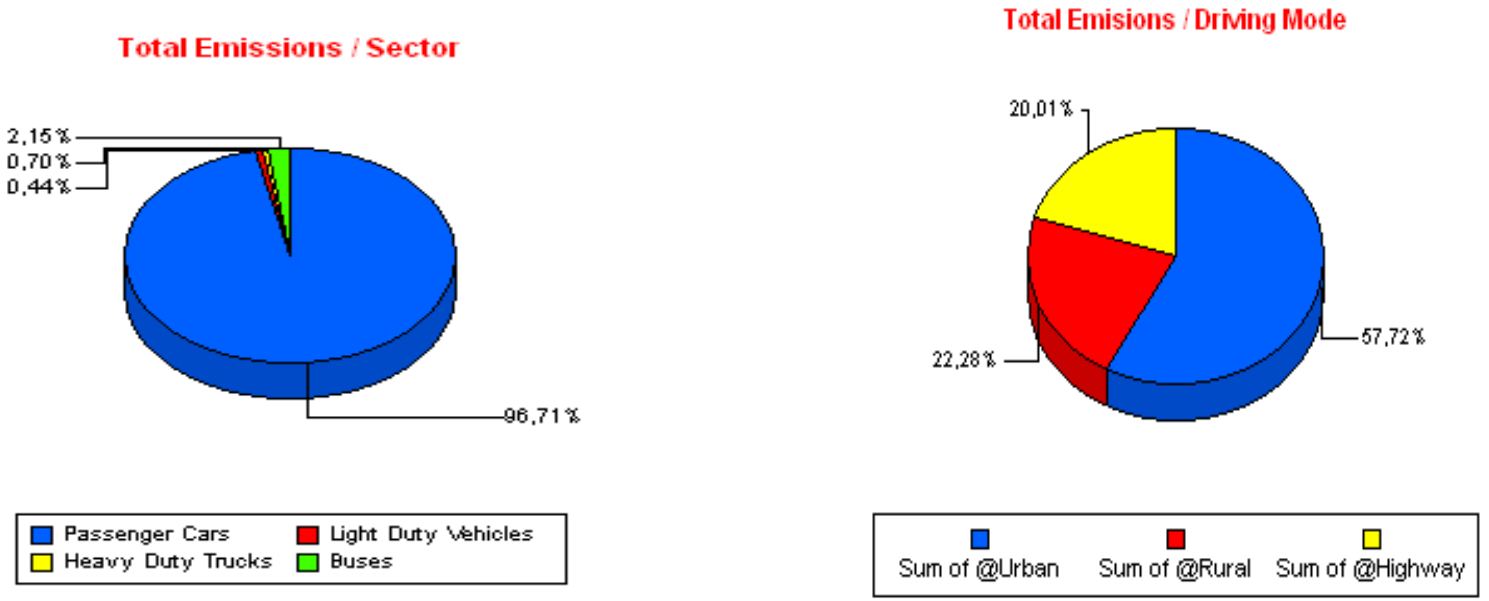


Figure 2. The data of carbon-dioxide CO2 vehicles types.

Methane emissions-CH4

Figure 3 shows the results of Methane emissions which is one of second GHG of Climate Change evaluated by COPERT 4. The amount of CH4 emission is about 2354 ton per year. According to the results of estimation of exhaust gases , share by light duty cars 96,7 % , heavy duty trucks is 0,70%, the share of light duty trucks is 0,44 %, by buses is 2,15 % and other parts by vehicles such as mopeds, motorcycles.

The share of methane emissions on the highways -57,7%, the urban streets 22,9% and 20,1 % on the rural ways.

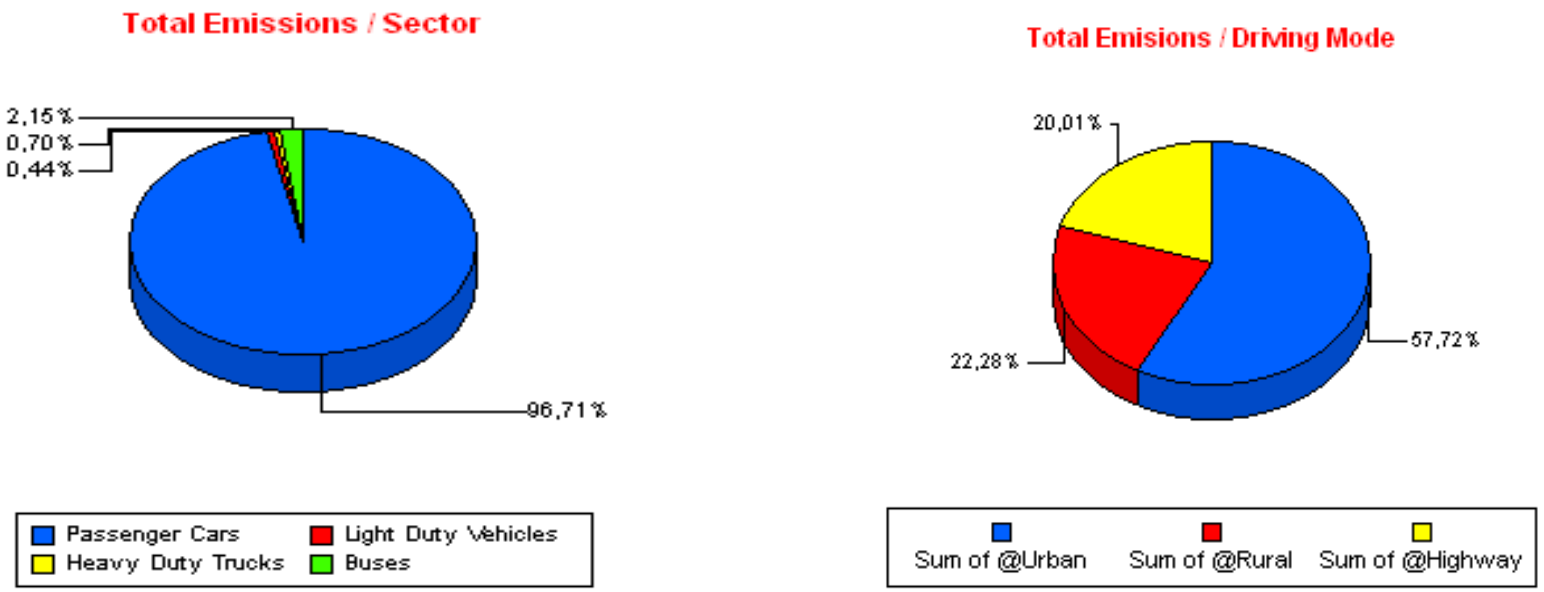


Figure 3. The data methane CH4 sharing among vehicles types.

Nitrous oxides N2O

Figure 4 shows the results of Nitrous oxides N2O emissions which is one of one of GHG evaluated by COPERT 4. The amount of Nitrous oxides N2O emissions is about 256,0 ton per year. According to the results, 88,5 % of Nitrous oxides N2O emissions by passenger cars, the share of buses is 7,8 % , the share of heavy duty trucks is 2,8 %, light duty commercial trucks is 0,77 %, and other parts of carbon –dioxide emissions by vehicles such a mopeds, motorcycles.
The share Nitrous oxides N2O emissions on the highways -34,9 %, the urban streets 41,7% and 23,7 % on the rural ways.

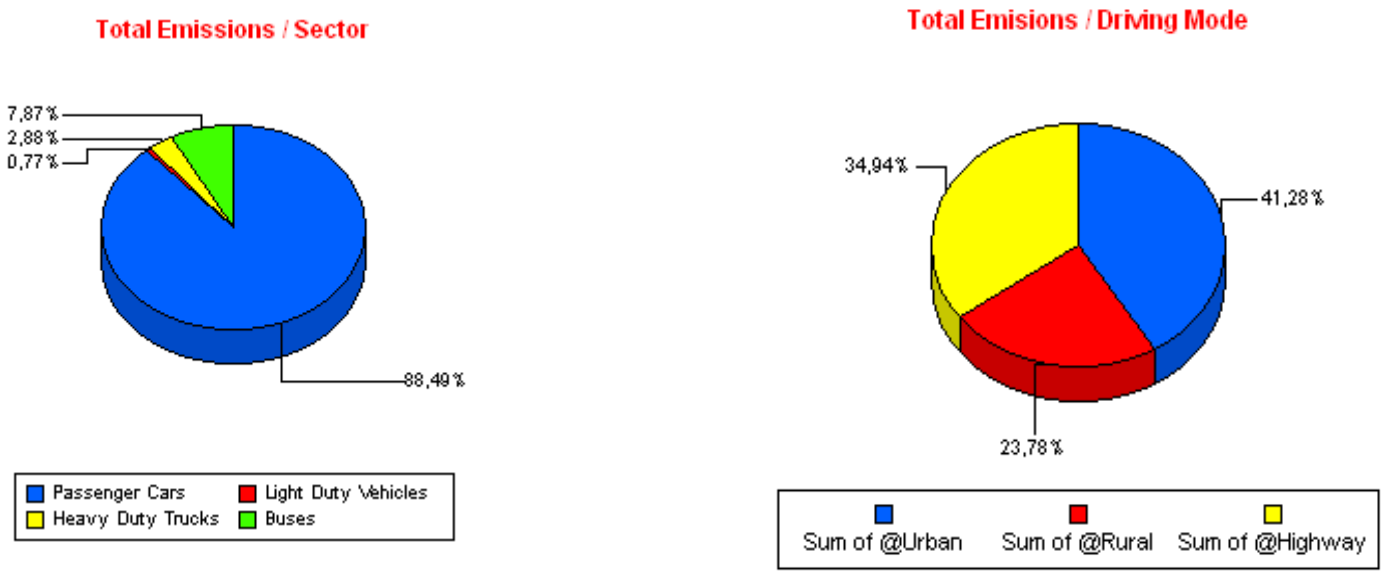


Figure 4. The data Nitrous oxides sharing among vehicles types.

The calculation of emission zones in Sumgait city and establishment of map spreading the pollutants to the city atmosphere by use of UPRZA software program

Picture. The map of researching streets..

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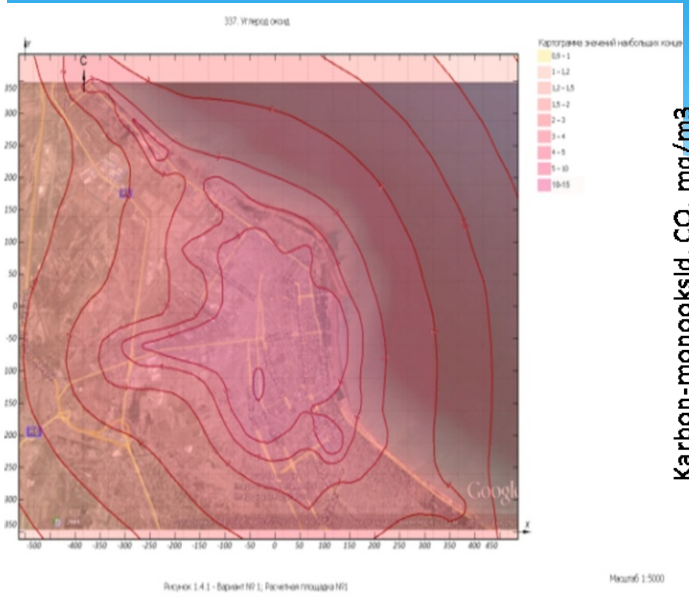
The map of pollutants spreading on the streets



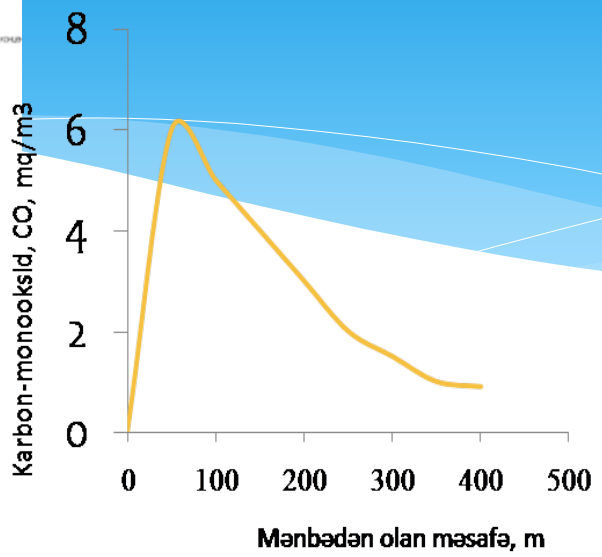
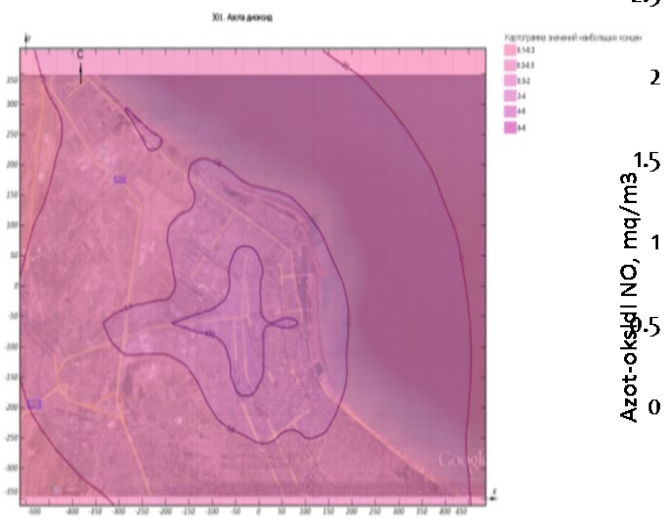
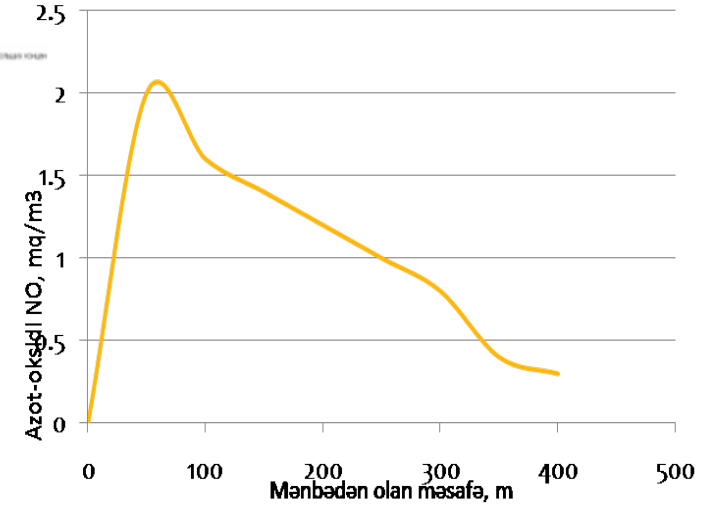


Figure 1. The CO-pollutants on the spreading across the street named Sulh . (annual average concentration permissible density limitYVQH -5mg/m3 once, 3 µg.m-3 mediate of day), Number of days with 8 hour running average ozone concentration exceeding 120 µg.m-3





Şəkil 2. The Nitrous oxides on the spreading across the street named Sulh . (permissible density limit 0,4 mg/m3 once, 0,6 mg/m3 mediate of day),

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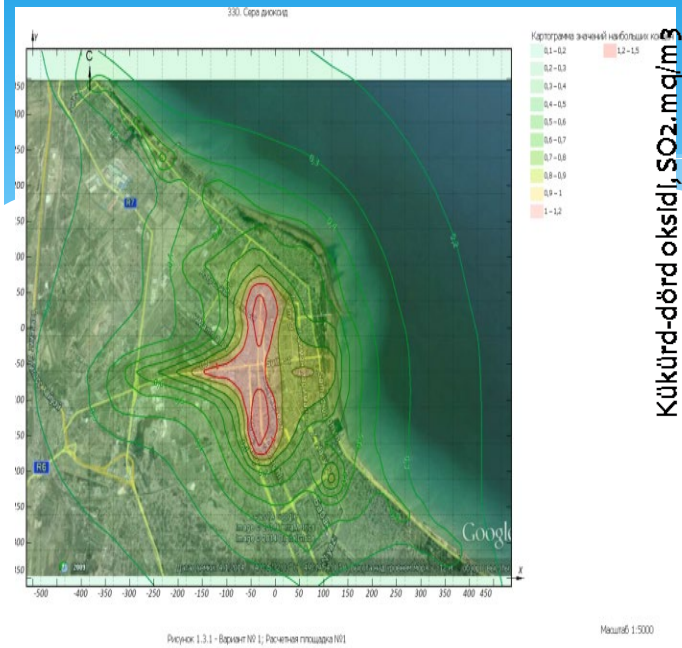
The map of pollutants spreading on the streets



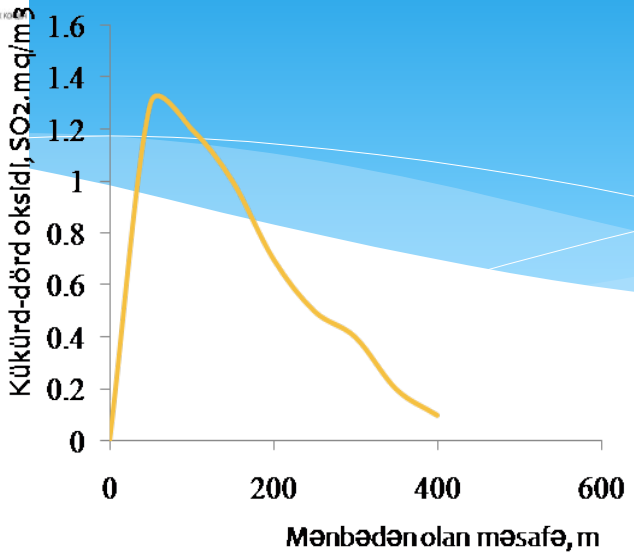
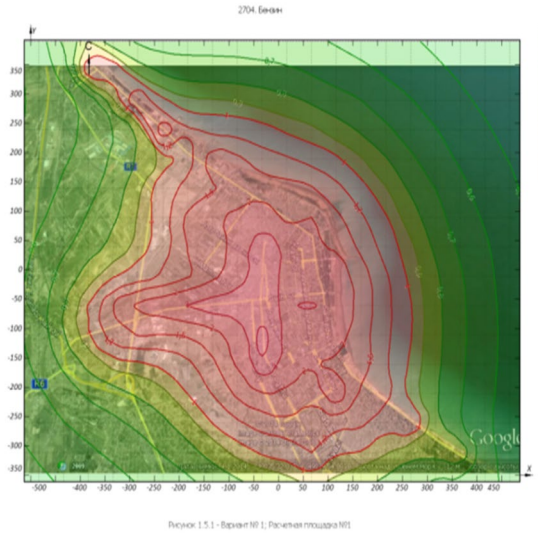
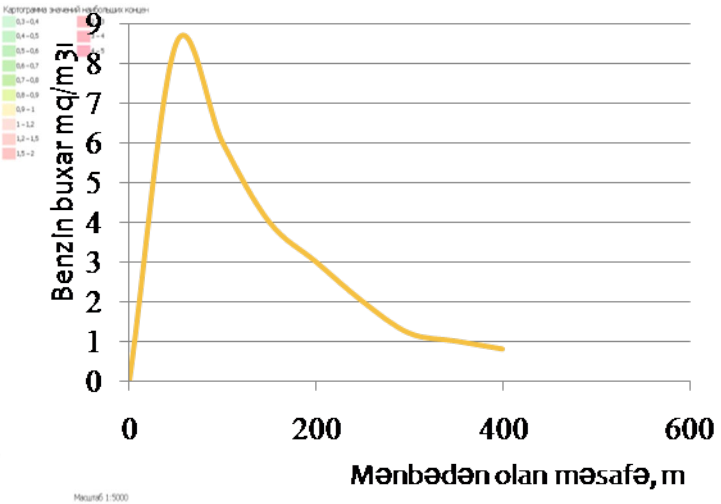


Figure 3. The CO-pollutants on the across the street named Sulh . (permissible density limitYVQH -5mg/m3 once, 3 mg/m3 mediate of day),

Sulh küçəsi boyunca atmosferdə kükürd-dioksidin (YVQH - 0,5mq/m3 birdəfəlik, 0,050 mq/m3 orta günlük), paylanma xəritəsi





Şəkil 4. Sulh küçəsi boyunca atmosferdə benzin buxarının (YVQH -5,0mq/m3 birdəfəlik, 1,50 mq/m3 orta günlük), paylanma xəritəsi

Results

* As a result of this study the amount of harmful emissions, especially GHG emissions such as (CO2, N2O, CH4) have been calculated by using the COPERT-4 program. The methodology proposed in this work is able to start from certification data to define modal emission rates of fuel consumption and NOx emission according to COPERT-4 software. This data and methodology can be further used in any other driving cycle, using the correspondent vehicle time distribution, to estimate fuel use and emission outcome in a given vehicle ore fleet of vehicles.
* The official method of calculation does not apply to wide range of parameters and does not account for a lot of parameters that determines the volume of emissions. Using this program we can determine the amount of fuel consumption and prepare forecasts for the future. The issue volume defines more precisely by means of this program, and it is easier to identify measures to reduce emissions.
* By using this software, you can determine the amount of greenhouse gases (GHG) and will prepare a policy on climate change. Using the opportunities of the program for determining emissions from cars can make an inventory of the sources and ways of reducing emissions, especially in cities such as Baku and Sumgait within a few years.

References

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Thanks for your attention!