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| Air Quality Governance in ENPI East Countries |
| **Development of tool for environmental assessment of different poliсies and measures for the development of national and municipal transport strategies** |
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**Summary**

Project Title: AIR QUALITY GOVERNANCE IN THE ENPI EAST COUNTRIES

Countries: Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova, Russian Federation and Ukraine

Focus country: All

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# Introduction

The Work Plan of the Project provides for provision of assistance to countries towards development of national and municipal transport strategies. The Project has been frequently requesting the countries to identify the type of specific assistance. However, only Ukraine and Moldova determined the type of assistance they need:

* Moldova – Recommendations on development of national transport strategy within the overall strategy on improvement of ambient air quality
* Ukraine – Recommendations on development of Ukraine’s strategy focused on implementation of the Gothenburg Protocol.

The rest of the countries were unable to determine a choice of the type of project assistance. Therefore they were proposed certain options taking into consideration the preliminary research under the project. In particular, one of the options provided for development of interface, which would facilitate the work with COPERT4 software for civil servants.

It is worth to noting that at the previous stages of the Project implementation in the area of transport the COPERT4 software has been used to prepare the basic inventory of pollutant and green-house emissions from transport. Afterwards using the same software the forecasts of emissions from transport under various scenarios of its development were elaborated. The Project ensured training for representatives of partners-countries how to use COPERT4 software. However the said software is quite complicated. In addition, the statistical data in partners-countries do not correspond to those available in EU countries, which mainly keep using COPERT4 software. Therefore the calculations with its use could be made only the specially trained experts. In the countries such experts were trained in 2012-2013. At that the civil servants, who are involved in development of strategic documents, could not use the COPERT4 software to assess the emissions decrease being achieved when implementing either political or technical action. Therefore the necessity is ripe to develop the software that would enable the civil servants to make calculations on COPERT4 software on the basis of available data of national statistics.

Such software could serve as an efficient instrument to develop national and municipal transport development strategies.

Such type of project assistance was selected by Armenia, Azerbaijan, Georgia and Belarus.

Upon request of the Ministry of Ecology of Belarus the general format when managing the traffic was additionally determined in the form of a set of key performance indicators, which would allow to determine how the municipal governance system corresponds to those tasks, which are set to it; besides, the approaches to arrangement of municipal transport ecological impact monitoring are generalised. As a summary this information is provided in this report as it can be useful for other countries as well.

# Received Results

The following short-term experts took part in the said activity:

* Armenia – Ara Marjanyan,
* Azerbaijan – Anar Mansurov,
* Belarus – Tatyana Vishnevetskaya.

Unfortunately in Georgia it was impossible to find an expert who would be able to perform such work.

The experts should develop the algorithms of data collection and processing, available at national level, and preparation of source data to be used by COPERT4 software;

* Develop the software to facilitate the work with COPERT4 software;
* Produce the user’s manual;
* Ensure training of civil servants.

All experts performed this work.

The software has been developing after consultancies with its potential users. Since the requirements of users differed the type of such software is different for different countries. The difference in structure of national statistics also affected.

Final reports of experts, user’s manuals and the software itself are given in individual folders.

The software is installed and is already being used in the Ministries of on environment protection of Armenia, Azerbaijan and Belarus.

# Approaches to Arrangement of Municipal Transport Ecological Impact Monitoring

# Analysis of problems and capacities of existing management system to impact the motor vehicles environment

At present worldwide the cities face the increasing pollution of environment, social and economic problems caused by inefficient transport systems, congestions/traffic jams, cost of roads and parking lots, traffic accidents, energy consumption and harmful emissions plus low mobility of non-motorized community. For lack of a set of generally accepted performance indicators and methodologies it is quite difficult to assess in a fairly manner an impact of concrete policy and technologies and to use lessons learnt from other cities.

Traditional solutions focused on planning of transport system such as expansion of road and traffic network often result in the converse effect: they contribute to increase of vehicles usage that causes quick growth of pollutant emissions. In contrast to this approach the innovative and efficient solutions on management of transport demand help us to achieve several planning purposes. It is possible to decrease emissions from transport by means of decrease of transport activity and to make people change environmentally cleaner modes of transport.

As the well-being of people grows their transport needs change: they are striving for higher mobility, higher level of transport services, comfort, speed and reliability. However it does not mean that cities with high level of revenues become dependent on automobiles. Cities, which improve efficient of pedestrian traffic, cycling and public transport and conduct an efficient pricing policy, can have an efficient transport system despite an increase of income of residents (Copenhagen, Vienna, Amsterdam etc.).

Most of large cities currently conduct monitoring of environment quality that is a large number of measurable parameters. The emissions are being measured depending on structure of transport flow, number of transport vehicles, transport characteristics, traffic conditions etc. The existing calculation models for measurement of emissions of from transport allow to making a quantitative assessment of pollution decrease due to any activities. The main parameters describing the road traffic are: average speed, maximal speed, number of stops, maneouvres of acceleration and slowdown, length of route and road grade.

The purpose of work is to determine the general structure when managing the road traffic in the form of set of key performance indicators, which allow to determine how the municipal government system corresponds to the tasks it faces.

At national level the own strategies and legislation are developed and currently in effect, which are being integrated into regional and local policy. In addition to regulatory and legal mechanisms one can see also a number of financial, educational and voluntary instruments.

The governmental authorities play an important role in development of strategies, which create favourable conditions at local territorial level, including those in cities.

Efficient governmental strategies towards assurance of ecological safety concern not only individual sectors but also include inter-sectoral and local territorial approaches, for which integration of territorial and climatic strategies is required. Below there are the instruments which in general could be used to speed up achieving the ecological safety of cities:

Sectoral and inter-sectoral instruments:

* regulation: legislation, operational norms, rules for utilities and governmental sector facilities, national action plans;
* financial and tax privileges: subsidies, taxes, social benefits/social security;
* facilitate development of new markets: creation and development of carbonic market, “green markets”, services in the area of energy efficiency;
* strategic programmes: strategic initiatives for governmental sector;
* advocacy and awareness raising activity and capacity building: educational programmes, technical assistance, access to information, awareness raising.

Territorial instruments:

* monitoring of fulfillment of national policy and tasks under competence of territorial bodies;
* national territorial and spatial planning and conditions of construction;
* modes of inter-spatial tax re-allocation;
* local investment programmes: infrastructure and ecological programmes, special programmes for vulnerable areas;
* handing prizes to the best regional and city authorities for achievements in the respective areas.

Since a number of sectors, which largely impact the ecological safety, are located within cities, the city authorities play a decisive role towards contribution to transformation of such sectors; they also fully influence upon local measures related to adaptation that is determined by their physical and structural proximity to local context and inhabitants. National and local bodies can realize their powers of authority through functions on regulation and planning, local fees, procurement procedures and direct administration of municipal property. They not only put into practice national policy and resources into practical implementation of strategies on the field but also champion innovations in the area of ecological safety policy. Moreover, even in absence of special norms and rules at national level the city administrations strive to take their own measures focused on response to ecological changes. A number of cities assumed more rigorous obligations to decrease emissions rather than target indicators set by their corresponding national governments. Certain cities even set an objective to achieve climatic neutrality thereby bringing this objective to reality.

Lack of set of accepted measureable performance indicators of transport system does to allow to fairly assess the existing situation and to forecast the consequences of concrete proposals (political and regulatory solutions, introduction of new technologies etc.). To assess quality and productivity of transport system the European Commission determined the critical aspects (key performance indicators) of transport system:

* Road traffic efficiency;
* Road traffic safety;
* Decrease of pollution level;
* Social integration.

It is very important to have quantitative assessment of the said indicators.

The overwhelming majority of strategies and managerial decisions are focused on improvement of road traffic efficiency. Although, typically, implementation of the concrete strategy and solution is focused on addressing several tasks, an improvement of road traffic efficiency is often a priority.

Road traffic efficiency encompasses the following indicators:

1. Mobility;
2. Reliability;
3. Operational efficiency;
4. Productivity.

Mobility means an ability of transport system to provide access to work, leisure, shopping, transport terminals etc. Measurement of mobility is an important part of quantitative assessment of productivity of the entire transport system as a whole.

Despite considerable improvements in the area of road traffic safety in the countries of European Union, USA and the Republic of Belarus, the road safety still remains an important aspect of transport planning as many people every day keep getting into road accidents that causes injuries and fatalities. To assess road traffic safety the following quantitative indicators are, typically, taken into account:

1. Traffic volume;
2. Death level at road accident;
3. Road accident level (number of road accidents per unit of traffic volume);
4. Severity of road accident

Globally the transport system consumes about 60% of the produced oil products and around 30% of the world generated energy. Input of transport system into environment pollution is a universally recognized fact and it is being discussed at all levels and in all countries. Modern cities face multiple problems associated with usage of vehicles: transport jams, fuel consumption, noise and ambient air pollution. All these factors cause worsening of life quality in the city and decrease attractiveness of life and work in downtown. Therefore, the quantitative assessment of pollution level from road traffic would allow to measure efficiency of activities focused on management of transport system.

# Modelling of road traffic intensiveness, assessment of existing emissions and dispersion of emissions

Currently most of large cities perform monitoring of environment quality that presents a large number of measured parameters. The models of correspondence assessment of transport system to the key indicators were developed; such models are based on a large number of measurements (for instance, ARTEMIS and COPERT), which allow to assess the emissions from the vehicles flow. In this particular case the emissions are calculated depending on structure of transport flow, number of vehicles, transport characteristics, road conditions etc. Thus, these models allow to making a quantitative assessment of pollution decrease due to either activities. Main parameters, which describe road traffic, are the following: average speed, maximal speed, number of stops, maneouvres of acceleration and slowdown, length of route and road grade.

Characteristics of road traffic, characteristics of street and road network together with characteristics of transport fleet are the key indicators and considered as source information for emission forecasting models from transport.

The following list of main measurable parameters allows to making the quantitative assessment of decrease of pollutions from automobile transport.

1. Information about the vehicles fleet. Structure of fleet by type and fuel with breakdown by age of vehicles on each category. For each category it is necessary to get an average mileage for the required time period;
2. Characteristics of road traffic. Intensity of vehicles by time and categories, number of stops and average speed by categories. Besides it is necessary to know maximal permissible speed at each section. Additional transport characteristics: average number of passengers and average duration of stop for each category of vehicles;
3. Characteristics of street and road network: average magnitude of grades, number of traffic lights.

Information about the vehicles fleet is, typically, provided by the respective institutions and the statistics committee. If the calculation includes public transport or transportation or goods then the corresponding information could be received from transport companies or operators of passenger traffic. The most reliable data on characteristics of road traffic are periodic in-situ measurements on street and road network, models of transport flow forecasting, positioning systems, monitoring systems and automated control systems. Characteristics of street and road network could be received by means of in-situ measurements, positioning systems or from the respective service public utilities.

To reliably measure the level of ambient air pollution from transport, the dispersion models should be used except for the emissions model. The models of pollutant emissions dispersion are mathematic simulation of distribution of pollutants into environment. The dispersion models are used to measure or forecast the concentration of pollutants from fixed sources and transport flows. The source data for dispersion modelling are the following:

* Meteorological conditions;
* Material and temperature of sources;
* Source parameters (altitude, position etc.);
* Location of customers (buildings, schools etc.);
* Characteristics and location of obstacles (buildings, schools etc.)

Such models as OSPM, AERMOD are the most common ones among the models of air dispersion or pollution dispersion models.

# Methodology of road traffic monitoring and critical aspects of transport system, control of key indicators in large residential points

# Basic definitions

Monitoring is a system of control, assessment and forecast of environment quality, including the observations of human impact.

Road traffic is movement of pedestrians and (or) vehicles on the road, including parking and stop within the road as well as the related public relations.

Road traffic arrangement is a set of organization and legal as well as organization and technical measures and regulatory actions on managing the traffic on roads focused on assurance of traffic safety.

Indicator is information on condition of environment that allows to quantitatively measuring the condition of ecological system and degree of achieving the management objectives.

Criterion is an indicator, sign, on the basis of which the assessment of ecological object, process is being formed.

Quality of environment are features of environment, which are determined as a result of objective measurements of environment parameters compared to the officially established, maximal permissible values of these parameters.

Quality of RTA is features of road traffic ensuring safety, efficiency and functioning of road traffic.

Scheme of monitoring of road traffic arrangement, control of transport system key indicators.

Methodology of monitoring of road traffic arrangement includes the following aspects:

1. Regulatory

2. Methodological (analytical)

3. Chorological

4. Information and technological

5. Functional

6. Organisational

7. Quality

The regulatory aspect includes the respective laws.

Methodological aspect of monitoring of road traffic arrangement contains the sequential set of methodologies:

* Characteristics of transport infrastructure;
* Characteristics of transport flows;
* Characteristics of emissions;
* Characteristics of dispersion;
* Characteristics of impact;
* Economic losses;
* Public opinion.

Chorological aspect takes into consideration the fact that monitoring is a multi-level system. In chorological system one can typically highlight the systems (or subsystems) of detailed, local, regional, national and global levels.

The lowest hierarchic level is a level of detailed monitoring being conducted within an individual transport flow on the segment of street and road network etc.

* Transport flow
* Parking
* Traffic police section
* Motorway
* District
* City (residential point)

When integrating the systems of detailed monitoring into larger network (for instance, within district etc.) the local level monitoring system is being formed. The purpose of local monitoring is to ensure assessment of system changes on larger area: territory of city, district.

Local systems could be integrated into larger ones – systems of regional monitoring covering the territories of regions within a region or oblast or within several of them. The similar systems of regional monitoring integrating the data of observation networks, which differ by approaches, parameters, territories of tracking and periodicity, allow to adequately forming the comprehensive assessments of the territories condition and to providing the forecasts of their development.

Information and technological aspect concerns the information receipt and processing.

The main functions of monitoring of road traffic arrangement system, control of transport system key indicators are the following:

* Determination of monitoring criteria
* Determination of monitoring indicators
* Measurement of indicators (source data)
* Calculation of indicators

Functional aspect covers all stages of project lifecycle.

Organisational aspect of monitoring of road traffic arrangement includes a set of organization and legal relations between the authorities in charge of road traffic arrangement and environment protection bodies.

Monitoring of quality of road traffic arrangement concerns the relations between four different points of view on quality of service related to road traffic arrangement.

The desired quality of service is a level of quality that implicitly or explicitly is required by users. Level of quality can be considered as a sum of many weighed qualitative criteria. The relative weight of these criteria can be assessed by qualitative analysis.

The target quality of service is a level of quality that service provider desires to provide to users. It is affected by level of desired quality required by uses, external and internal circumstances, budget and technical restrictions, level of competitors. The target service quality is formulated by declaration of service standard or level of achieving or assessment of share of users who profit from standard service, or by threshold of non-permissible.

The provided service quality is a level of quality achieved on a continuous basis. The provided quality is measured from the point of view of user. It is not just technical assessment showing that the process was finished; it takes into consideration the meaning of service.

The provided quality can be measured using statistical and observed direct quality criteria.

The perceived service quality is a level of quality perceived by users. Perception of the provided quality by user depends on their personal experience of service or related services, information they receive about such service – from supplier or from other sources – or personal factors.

Difference between the “desired quality” and “target quality” determines the extent to which service providers are able to direct the efforts towards meeting the needs of users.

Difference between the “target quality” and “provided quality” is a measure of efficiency of service providers to achieve their objectives.

Difference between the “perceived quality” and “provided quality” characterizes knowledge of user about the provided service, difference in personal experience and personal characteristics of user and environment.

Difference between the “desired quality” and “perceived quality” can be measured as a degree of satisfaction of user.

Application of principles of quality loop to any quality management scheme envisages the following:

* Determination or assessment of explicit or implicit expectations of user;
* Determination and declaration of viable and provided service taking into consideration the expectations of user;
* Production of service in accordance with quality requirements (including measurement of quality and adjusting action);
* Communication of results to users;
* Measurement of user’s satisfaction;
* Analysis of results and taking the respective action.

# Institutional and methodological mechanisms of monitoring system

The model activities related to decrease of pollutant emissions for streets of residential points could be split into the following main groups:

1. Promote the ecologically efficient transport models:

* Improve transit traffic;
* Develop cycling and walking;
* Develop public transport system;
* Develop the car and bicycle, car and public transport sharing systems (sharing systems);
* Conduct public campaigns and actions towards advocacy of alternative “green” transport models (day without automobile etc.).

2. Encourage decrease of usage of private automobiles:

* Fee for entry into downtown (fee for congestion street and road network);
* Introduce tolls, arrange paid sections of streets or motorways;
* Balance the parking proposals;
* Introduce parking fee;
* Control how the parking rules are met.

3. Land use management:

* Policy of “smart” growth;
* Develop transit;
* Create the housing stock without using automobiles;
* Actions to mitigate traffic;
* Priority to pedestrian “human-oriented” models;
* Develop remote operation schemes and flexible schedule.

4. Improve street and road network:

* Design street and road network for human needs;
* Improve intra-urban links;
* Reconstruct “critical” transport junctions;
* Introduce intellectual transport system, automated road traffic control system;
* Transport control;
* Speed mode system;
* Create obstacle-free environment;
* Create the parking management and control system.

5. Encourage usage of ecologically clean vehicles:

* Create ecological zones;
* Surcharges (financial preferences) for usage of vehicles with low level of pollutants emissions;
* Programmes on disposal of vehicles as well as trade-in programme when purchasing new automobiles;
* Technical inspection and maintenance of vehicles.

There is a lot of actions focused on optimization of functioning of public transport and making it more attractive for consumers without high investments in development of street and road network:

* Decrease intervals and increase of duration of functioning;
* Prioritize the public transport: designate lanes for public transport, introduce priority traffic light signals for public transport or any other activities to reduce delays of transit public transport;
* Improve conditions of trips such as minimization of overcrowding, improved seats and clean rolling stock;
* More comfortable and integrated payment system, electronic payment system;
* Decrease cost of trip, discount systems, attractive proposals for random (rare) users and discount programmes for employers;
* Convenient information system for users: signs and plates, Internet resources and mobile applications informing about schedule and routes of public transport traffic based on reliable online information about rolling stock arrival;
* Provide the integrated systems for payment for services of municipal ground transport with metro, suburban, interurban and rail transport,
* Improve stop grounds, waiting halls;
* Improve infrastructure for pedestrians and cyclists within stop points;
* Improve safety for passengers and pedestrians;
* Develop the park-ride systems and intercepting parking;
* Special service for target needs such as shuttle routes, routes with rolling stock of lower capacity, with rolling stock of higher comfort.

Development of walking and cycling traffic system result, first of all, in creation of obstacle-free environment:

* Improve and bring to necessary standards the pavements, footways, pedestrian crossings;
* Adapt the existing pavements for cycling, create and develop the system of bicycle lanes as well as improve the bicycle crossings;
* Develop the bicycle parking system;
* Develop the bicycle and other transport modes sharing programme;
* Apply the tactile and contrasting elements of coating on pavements and pedestrian footways;
* Develop the programme of preventing the vehicles from driving onto pavements and pedestrian footways (mounting the poles, booths, fencings etc.).
* Design of street and road network for human needs or design of “common” environment includes infrastructure for pedestrians, cyclists, public transport and automobiles.

The activities to mitigate traffic include the following measures:

* Reduce the maximal permissible speed for traffic;
* Introduce artificial unevenness;
* Implement actions to make the roadway narrower (construction of “semi-islands”);
* Introduce mini rings on crossings;
* Blocking (making blind alleys) of transit streets;
* Introduce the speed mode breaching video recording system.
* Construction of toll sections of streets or motorways allows to repaying or partially compensating the costs of road services for construction, repair and operation of streets; it also reduces transport demand and pollution of ambient air. Introduction of fee for downtown entry (fee for congestion of street and road network) may have the following options:
* Entry fee: payment for entry into the congested (central) zone of the city. Fee could be higher in peak hours;
* Zone season ticket: vehicle buys the season ticket (for instance: daytime) for trips or stay in a certain zone;
* Toll lanes: in congested places on multiple-lane motorways the lanes are designated where the toll is collected.
* Development of parking management system includes the following main actions:
* Parking demand management (expansion of paid parking zones, paid parking in dormitory areas and neighbourhood areas);
* Parking space offer management (orientation and communication system, joint usage of parking space (housing at night-time, trade and business at day-time etc.);
* Create the parking systems focused on public transport (intercepting parking);
* Develop the parking control system.

The parking management system should be a part of the whole transport management system, which is interlinked with public transport management system.

To assess quality of road traffic it is necessary to structure the street and road network by statuses depending on transport load, speed of communication, and metropolitan classification of traffic police sections.

For each status it is necessary to determine a set of target indicators. Exceeding of the set values is inadmissible and requires special activities related to improvement of traffic conditions. The main actions focused on improvement of traffic conditions are the following:

* Actions on assurance of throughput balance across the whole street;
* Actions to prevent parking near crossings;
* At the sections with traffic light regulation it is necessary to arrange the coordinated management of traffic light facilities;
* Adjust the operation mode of traffic light facilities depending on daily, weekly and seasonal unevenness of load;
* Replacement of artificial unevenness into alternative means of traffic mitigation: video control of speed modes, elevated sections of roadway of larger area, bus “cushions”, narrowing of roadway, “semi-islands”, mini rings, introduction of traffic light regulation;
* Construction of Z-shaped pedestrian crossings;
* Increase the throughput of transport junctions.
* Increase the throughput of transport junctions by means of the following actions:
* Designate lanes for turning transport;
* Channelize transport flows;
* Adjust the operation mode of traffic light facility by time of the day according to total ecological losses;
* Prohibit the certain directions of transport traffic;
* Prohibit the certain directions of pedestrian movement;
* Broadening the entries in front of crossing (adding the traffic lanes both at the expense of constructive broadening of motorway and due to decrease of width of the existing traffic lanes);
* Reconstruction of crossing;
* Construct interchange.

# Conclusion

Characteristics of road traffic, characteristics of street and road network together with characteristics of transport fleet are the key indicators and considered as source information for emission forecasting models from transport.

Information about intensity, structure of flow is, typically, provided by design and operating organisations. If monitoring includes the public transport then the respective information can be given from operators of passenger traffic. The most reliable data on characteristics of road traffic one can receive by means of periodic in-situ measurements on street and road network or from running laboratory using the automated monitoring systems and automated control systems. Characteristics of street and road network could be received by means of in-situ measurements, positioning systems or from the respective service public utilities or design organisations.