UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

Improving capacities of the UNECE member States to decarbonize the transport sector by increasing the use of natural gas as a motor fuel

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Abbreviations

Bcm	Billion cubic meters
BEV	Battery Electric Vehicle
CH4	Methane
CO_2	Carbon dioxide
CO_2-eq	Carbon dioxide equivalent
CNG	Compressed Natural Gas
EBRD	European Bank for reconstruction and development
EU	European Union
EV	Electric vehicle
FCEV	Fuel cell electric vehicle
GTL	Gas to liquid
GHG	Greenhouse gas
GDP	Gross domestic product
H	Hydrogen
HDV	Heavy-duty vehicle
ICE	Internal combustion engine
IGU	International Gas Union
IEA	International Energy Agency
ISO	International Organization for Standardization
LCA	Life cycle assessment (analysis)
LCV	Light commercial vehicle
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
Btu	British thermal unit
NDC	Nationally Determined Contributions
NG	Natural gas
NGV	Natural gas for vehicles
NOx	Nitrogen oxide
OECD	Organization for Economic Cooperation and Development
SDG	Sustainable Development Goals
PM	Particulate matters
RES	Renewable Energy Source
Sox	Sulfur oxides
T&E	European Federation for Transport and Environment
UN	United Nations
UN ECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WHO	World Health Organization

Terms

The **Agenda 2030 for Sustainable Development** is a global action plan for **Sustainable Development Goals (SDGs)** or **Global Goals,** a collection of 17 interlinked global goals and 169 targets that will stimulate action in areas of critical importance for humanity. The SDGs were set in the United Nations General Assembly Resolution in 2015 and are intended to be achieved by the year 2030.

CO_2 equivalent is a metric measure used to compare the emissions from various GHGs based upon their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same GWP.

Decarbonization tends to refer to the process of reducing 'carbon intensity', lowering the amount of greenhouse gas emissions produced by the burning of fossil fuels. Generally, this involves decreasing CO2 output per unit of generated electricity. Reducing the amount of carbon dioxide caused by transport and power generation is essential to meet global temperature standards set by the Paris Agreement.

Life cycle assessment is a methodology for assessing environmental impacts associated with all the stages of the life cycle of a vehicle. From cradle to grave means that environmental impacts are assessed at all stages of a product's life, which is from raw material extraction and processing (cradle), through the product's manufacture, distribution, and use to the recycling or final disposal of the materials composing it (grave).

Nationally Determined Contributions (NDCs) embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement (Article 4, paragraph 2) requires each Party to prepare, communicate and maintain successive NDCs that it intends to achieve. Parties shall pursue domestic mitigation measures, so as to achieve the objectives of such contributions.

The Paris Agreement is a global agreement negotiated by 189 states that targets the substantial reduction of global greenhouse gas emissions to limit the global warming in the present century to 2°C and pursuing further efforts to limit it to 1.5°C.

Sustainable transport is an optimal infrastructure and public transport systems, goods delivery networks, affordability, efficiency and convenience of transportation, as well as improvement of urban air quality, health, and reduction of greenhouse gas emissions. Sustainable transport is mainstreamed across several SDGs and targets, especially those related to food security, health, energy, economic growth, infrastructure, and cities and human settlements.

Transport transition is a wide range of policies to align the transportation characteristics with the 2.0°C and further with the 1.5°C pathways. It implies over time the improvement of transportation specific efficiency for road-, rail- and aviation transport technologies through the development of transport systems and their adoption at a country-level in order to reduce oil dependency, greenhouse gas emissions and air pollution.

Contents

Figures and Tables

Introduction

This paper is an outcome of an extra-budgetary project "Improving capacities of the UNECE member states to decarbonize the transport sector by increasing the use of natural gas as a motor fuel". The project promotes decarbonization of the UNECE member States' transport sectors by switching from petrol and diesel to compressed or liquefied natural gas (CNG or LNG), thus reducing transport emissions and improving energy efficiency. The Project was run under the auspices of the UNECE Committee on Sustainable Energy to support the work of the Group of Experts on Gas. This paper focuses on the role of natural gas in the transport transition. It describes the state-of-the-art of the NGV markets and its perspectives in:

- Armenia,
- Azerbaijan,
- Belarus,
- Bosnia and Herzegovina,
- Bulgaria,
- Kazakhstan,
- Kyrgyzstan,
- Moldova,
- North Macedonia,
- Romania,
- Serbia,
- Tajikistan,
- Turkmenistan,
- Uzbekistan.

The key characteristics of the NGV market development level (number of filling stations and number of vehicles using natural gas) are: motorization rate, access to natural gas and natural gas network coverage.

Sources of statistical data: United Nations, World Bank, UNECE statistical database, International Energy Agency, Organization for Economic Co-operation and Development, ACEA (European Automobile Manufactures' Association), national statistical databases.

Plans and perspectives of local NGV markets are based on official development programs and official declarations.

The report consists of the following sections:

- NGV market development and United Nations' sustainable development goals (SDGs),
- Life cycle analysis,
- Overview of the target countries,
- Country profiles
- Comparative analysis of safety requirements for refueling stations,

- Public opinion research,
- Case studies
- Recommendations for organizing future research,
- The list of promo-materials –links to video-materials about NGV to be used for promoting NGV in respective countries.

The paper can be useful for three types of readers/users:

1. Officials in UNECE countries,
2. Analysts of NGV market,
3. Individuals, who are interested in transport transition options.

For the first group the spotlights are the country profiles, public opinion research, case studies, recommendations and promo-materials.
For the second group: the connection to SDGs, Life cycle analysis, general description of the target countries, comparative analysis of safety requirements for refueling stations and recommendations.
For the third group: the connection to SDGs, general description of the target countries, public opinion research, case studies, recommendations and promo-materials.

Transport transition to a sustainable transport system foresees for decrease in energy use and safe, affordable, accessible, effective and eco neutral fleet. There are two options for the pathway: structural optimization and transition to fuel mix.
Structural changes like improving logistics, expanding public transport, introducing sharing mechanisms and unmanned technologies, as well as providing distant working and 3D printing can bring around 30% decrease. That is why the shift in the fuel mix is crucial in greenhouse gas emissions (GHG) and local air-pollution reduction.
There are some alternatives for traditional oil fuels:

- improving the environmental aspects of gasoline and diesel engines (Euro 5,6 and further),
- battery electric vehicles (BEV),
- liquid petroleum gases (LPG),
- natural gas for vehicles (NGV) – compressed (CNG) and liquefied (LNG),
- biofuel,
- methane-hydrogen mix,
- hydrogen for vehicles – fuel cells (FCEV).

There is a limit for the traditional oil engine efficiency improvements, so the alternatives to diesel and oil vehicles there are now widely discussed. The cost of EVs and FCEVs are so high that it is out of reach for developing countries in the perspective of 10-20 years. LPG vehicles are quite cheap and efficient but spoil air quality in urban sectors no less than the traditional oil fuel. CNG and LNG transport are the cleanest in terms of local pollution and 20-25% more efficient in terms of GHG emission compared to oil fueled engines.

The role of natural gas as environmental-friendly fuel was highlighted by UN Resolution 75/221 in December 2020: "*Recognizes the key role that natural gas currently plays in many countries and its potential to expand significantly over the coming decades to meet demand in some countries as well as in new sectors, such as the transportation sector, supporting transitions towards lower-emission energy systems, and calls upon Governments to enhance energy security through the sharing of best practices and knowledge for the security of gas supply and demand"*.
There is a good potential for natural gas to become a transition fuel as there are opportunities to switch to synthetic gases like bio methane and hydrogen-methane mix.
All one needs to use natural gas in transport is vehicle retrofit that improves its energy and environmental characteristics.

If you have any questions, comments and concerns about this report, you can send it to natural.gas@un.org.

Executive Summary

You can find the Executive summary in the separate document (link).

Transport Transition and Sustainable Development Goals

The global agenda on climate change was ratified by the majority of countries in 1992. In compliance with the Paris Climate Agreement of 2015 the greenhouse gas (GHG) emissions are to be reduced in order to achieve carbon neutrality by 2050.
According to IEA Transport sector is responsible for more than 25% of the global GHG emission, and the figure has been ever-growing annually since 1990. Today the transport sector is more than 90% dependent on liquid fuel.

The United Nations (UN) 2030 agenda sets forth 17 Sustainable Development Goals. Many of the SDCs are related to transport: improvements in urban air and water quality, economic growth, sustainable cities, and communities, access to energy, climate action. Transport plays a significant role in supporting local, national, and regional economies and urban environment.
According to the World Health Organization "from smog hanging over cities to smoke inside the home, air pollution poses a major threat to health and climate. Ambient air pollution accounts for an estimated 4.2 million deaths per year due to stroke, heart disease, lung cancer, acute and chronic respiratory diseases".
The issue is particularly acute for developing countries as their vehicle fleet is old. The role of transport is pivotal in reaching SDGs and climate goals. This is a significant challenge for the countries to find a sustainable way for transport transition as the latter is related to at least 8 sustainable development goals. The table below shows the principal correlation between NGV market development and the sustainable development framework.

Table 1. Connection between NGV market development and SDGs

SDG	Influence factor	Description
SDG #1. No poverty	Low price of natural gas compared to diesel and gasoline. Low cost of CNG car ownership	The lower is the disposable income, the higher is the share of transportation costs. Thus, the possibility of reducing transport costs is very sensitive for socially vulnerable segments of the population. The mobility should be available and affordable for the citizens. That means that transport transition should lead to reduction of transport and logistics costs due to cheap efficient fuel solutions. At the same time, not only the cost of fuel is important for the consumer, but also the cost of the vehicle itself, which determines the cost of ownership over the entire life cycle. From this viewpoint LPG and NGV seem the most attractive alternatives for the global transportation cost reduction.
SDG #3. Good health and well-being	NGV allows to minimize the emissions of particulate	Transport as a source of toxic emissions has a negative impact on the environment and human health. The emissions of particulate matter (PM10, PM2.5) that contain compounds of sulfur, heavy metals, aldehydes,

SDG	Influence factor	Description
	matter (PM10, PM2.5)	benzopyrene, etc. have a particularly harmful effect on human health. If we look at the transformation of the transport sector from the environmental and human health perspectives, then firstly we must reduce the share of petroleum fuels - gasoline, diesel and liquified petroleum gas (LPG).
SDG #6. Clean water and sanitation	Usage of natural gas as a motor fuel for water transport allows to avoid fuel spills	Globally the most common source of drinking water are rivers and lakes. At the same time, these rivers and lakes are often used as transport infrastructure. Thus, water transport affects the water quality. That is why for water transport it is very important to use fuel that minimizes the risk of spillage of harmful substances into rivers and lakes. The most promising fuels from this point of view are electricity, LNG, and hydrogen.
SDG #8. Decent work and economic growth	Low price of natural gas compared to diesel and gasoline. Natural gas cannot be stolen from the fuel tank, unlike gasoline and diesel	Acceleration of economic growth is possible by increasing the efficiency of the transport sector and reducing transport and logistics costs. As noted above, one of the ways to reduce the cost of transportation is the transition to cheaper and more efficient types of fuel, which today include electricity (in case of cheap power generation), LPG and natural gas. An additional factor is that these fuels cannot be stolen from the fuel tank, unlike gasoline and diesel.
SDG #9. Industry, innovation, and infrastructure	The development of CNG and LNG gas station infrastructure increase the access of final customer to natural gas as an alternative fuel	Providing access to different types of transport requires a refueling infrastructure covering all alternative fuels on key transport routes. This fact presupposes the transformation of existing approaches to fuel infrastructure development. Key transport routes should be saturated with multi-fuel complexes that allow refueling not only with gasoline and diesel, but also with CNG, LNG, hydrogen, and electricity. The target 9.4 defines to upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities by 2030.
SDG #10. Reduced inequalities	Low price of natural gas compared to diesel and gasoline. Low cost of CNG car ownership	Poor people deserve a quality environment no less than wealthy people. Providing access to cheap types of environmental fuel (primarily natural gas) is one of the effective pathway to provide clean air in urban for people with low income. The introduction of cheap fuel increases the disposable income of households. NGV is much cheaper way to improve urban air quality and contribute to decarbonization.
SDG #11. Sustainable cities and communities	NGV allows to minimize the emissions of particulate	The quality of the urban environment and the health of urban residents is mostly determined by the cleanliness of the air. Therefore, the transition of transport to greener

SDG	Influence factor	Description
	matter (PM10, PM2.5)	fuels is a key driver of sustainable development of modern cities. By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons
SDG #13. Climate action	CNG and LNG technologies are mature and can be simply implemented in medium-term	Transport emission reduction goal is more complex than reducing emissions in the power sector. Hydrogen seems to be the most attractive fuel for transition in the transport sector. But hydrogen technologies cannot be massively implemented in a short time. The world community needs to create new supply chains of hydrogen for transport. Therefore, if we are talking about achieving sustainable development goals until 2030, then it is necessary to place a bet on mature technologies

Life Cycle Analysis of Competing Fueling Options

Environmental problems related to the use of traditional motor fuel in vehicle engines are relevant for all countries in the world. Many countries are on the way to adopt strict ecological requirements for vehicles.

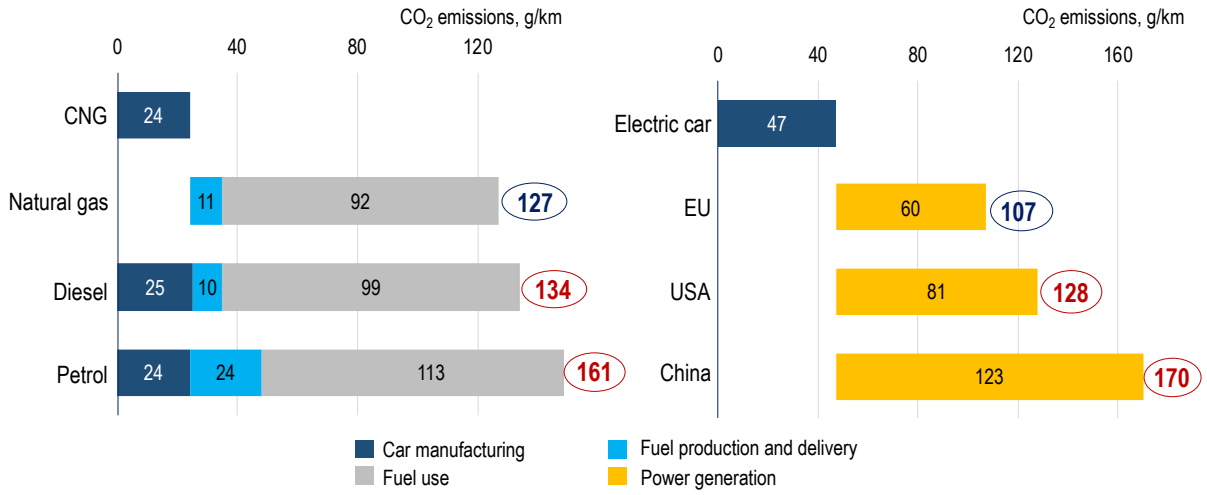
Automakers have announced their commitments to achieve zero emissions and to produce climate and urban environment friendly vehicles. The most environmental friendly types of fuels that do not cause significant harm to the environment are natural gas, hydrogen and electricity and they are the best alternatives to gasoline and diesel.

Given the economic component, natural gas is the most affordable source of energy that can have a significant impact on the environment in a short- and long- term perspective.

Advertising of electric vehicle makes the consumers believe that electric cars are the most environmental friendly type of motor vehicles. It is controversial if we take the full life cycle analysis. It is important to assess not only the final emissions from the fuel combustion but also the full cycle of pollutant emissions at all stages of vehicle production and utilization, as well as at all stages of fuel production and processing.

Life cycle analysis was initiated in Volkswagen Group about 10 years ago. The results of this project were actively discussed in 2014-2017. The final calculations can change a bit from year to year, but the main findings remain clear. The following figure shows main calculations of full lifecycle emissions for different types of fuel. Natural gas emissions were calculated without biogas. Diesel and petrol emissions were calculated according to the requirements of the EU Directive 2009/28/EC with the addition of 7% biodiesel and 5% bioethanol. All the calculations are made for Volkswagen Golf with 200 000 km run.

Figure 1. Estimation of full life cycle CO_2 emissions for different types of fuel



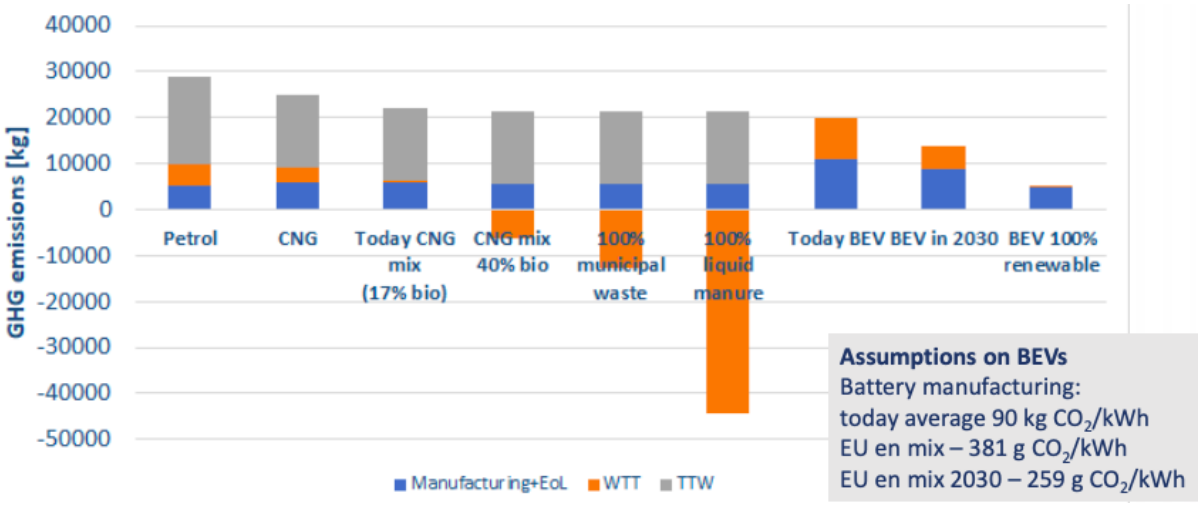
Source: Volkswagen Group

Here are the main messages worth highlighting:

1. Emissions for natural gas vehicles manufacturing are the same as for petrol cars, at the same time manufacturing of battery electric vehicle results in double emissions. LCA shows that more than 40% of emissions from BEV manufacturing comes from the battery. The manufacturer uses a lot of power for battery production.
2. Natural gas is preferable compared to diesel and gasoline. Addition of biofuel can reduce emissions for all fuels accordingly.
3. The main factor affecting BEV emissions is power mix of the country / region where BEV is used.
4. The battery disposal remains an urgent problem for research. The potential harmful effects of used batteries on the environment have not been adequately assessed. In its turn, the cost of organizing battery recycling will increase the cost of transition to BEV.

These basic findings are supported by other authoritative research. For example, NGVA Europe provides the Cradle to Grave GHG emissions study. The study shows that BEV can be effective only with increasing share of renewables in the power mix.

Figure 2. Cradle to Grave GHG emissions comparison

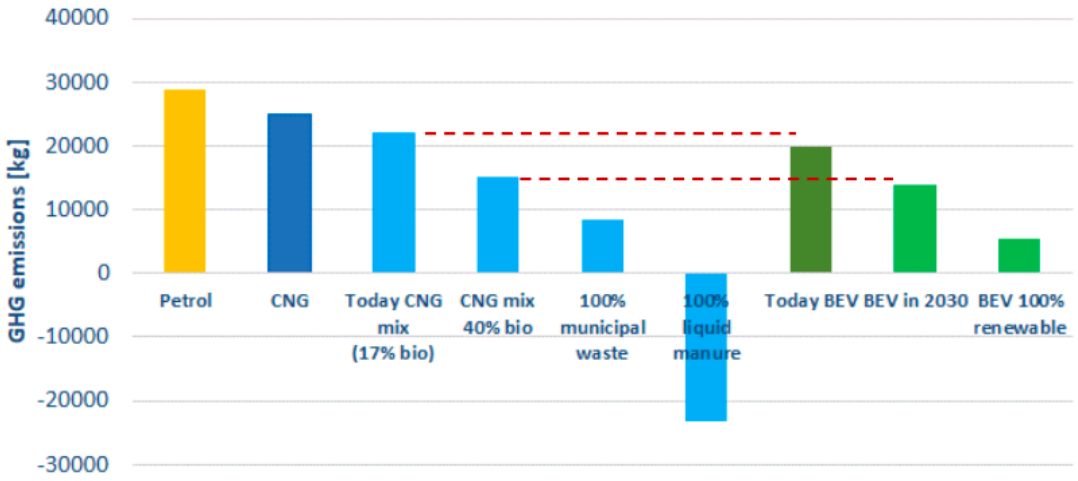


Source: NGVA Europe

More important is the fact that in the case of using a mixture of natural gas and biogas or hydrogen blends as a fuel, gas fuel remains competitive in the long run compared to electric vehicles in terms of ecology (Figure 3).

An integrated approach involves the active use of municipal and agricultural waste for the production of biogas. This solution allows achieving synergistic effects that significantly improve the quality of the environment. By consuming waste as a resource for fuel, the transport sector is transforming from a producer to an absorber of GHG emissions.

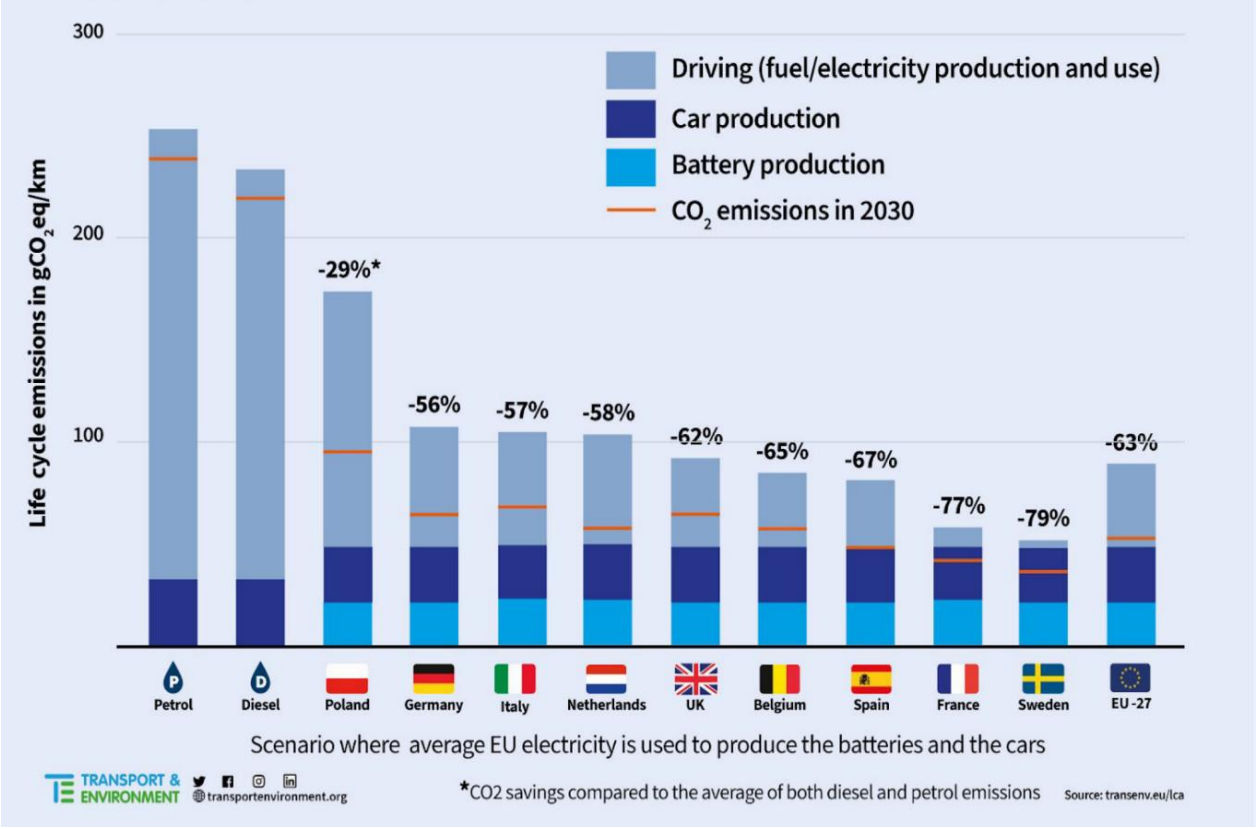
Figure 3. Cradle to Grave GHG emissions, total



Source: NGVA Europe

Similar estimates of emissions from electric vehicles are presented in the study of T&E "How clean are electric cars? T&E`s analysis of electric car lifecycle" (Figure 4). It should be mentioned that the real numbers for some European countries should not include emissions from battery production. But the problem of battery disposal, on the other hand, must be assessed for every country, in addition to presented calculations.

Figure 4. Lifetime CO_2 emission savings from electric cars in key EU countries



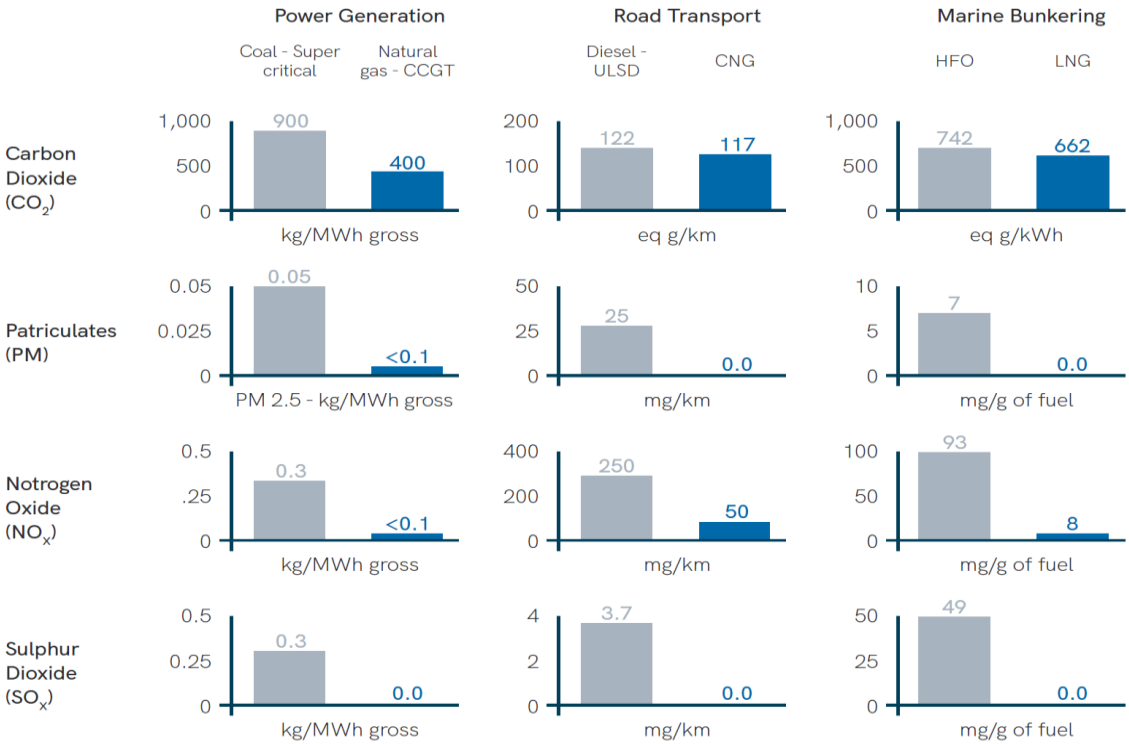
Source: T&E

According to the review of Ch. Aichberger and G. Jungmeier (LIFE — Institute for Climate, Energy and Society, Joanneum Research Forschungsgesellschaft mbH) "Environmental Life Cycle Impacts of Automotive Batteries Based on a Literature Review", most of the research of the environmental impact of electric battery production and operation do not consider the need for their subsequent disposal or recycling. Several conclusions can be drawn from this. 1) GHG emissions for EV are underestimated due to neglecting the volume of emissions from recycling. 2) The costs of transition to electric mobility should be increased by the capital costs of the electric batteries processing centers.

At the same time, if you look at the Figure 4, you will see a significant difference in the emissions from Battery Electric Vehicles in different countries. For example, the BEV emissions in Poland are almost two times higher than the EU average. The main reason for such is the energy mix, which is mostly coal-based for the power industry of Poland. Thus, when analyzing environmental and economic efficiency of the transition to Natural Gas Vehicles or BEVs, one should look into the energy mix of every country in detail. In our study special attention was given to development prospects of energy sectors on country level.

There is one more important finding of the lifecycle analysis: CO_2 is not the only compound to be considered when assessing the environmental impact of transport. According to the International Gas Union, natural gas technologies, as opposed to oil-based fuels that enhance the pollution load, offer an immediate solution through the reduction of pollutants concentration in the air, including particulate matter, nitrogen oxide (NO_X), sulfur dioxide and ozone, providing for unpolluted air together with further climate benefits.

Figure 5. Emissions factors for natural gas vs. diesel



Source: IGU, NETL, EEA, OIES, BCG analysis

Solid particles absorb associated harmful emissions, thus provoking the ingress of harmful substances into human body.

Harmful substances from vehicles are of special danger for human health mostly because they can be spread in the surface layer far away to residential areas, including courtyards. Exhaust particles are a complex mixture that depends on the operation of the engine, fuel composition, lubricating oil, cleaning agent exhaust gases. Many elements like V, Cr, Mn, Fe, Ni, Cu, Zn, Cd, Pb, are widespread in solid components of exhaust gases and therefore an important source of toxic substances[4].

The use of natural gas –allows to get rid of particulate matter in the air, particularly hazardous to human health

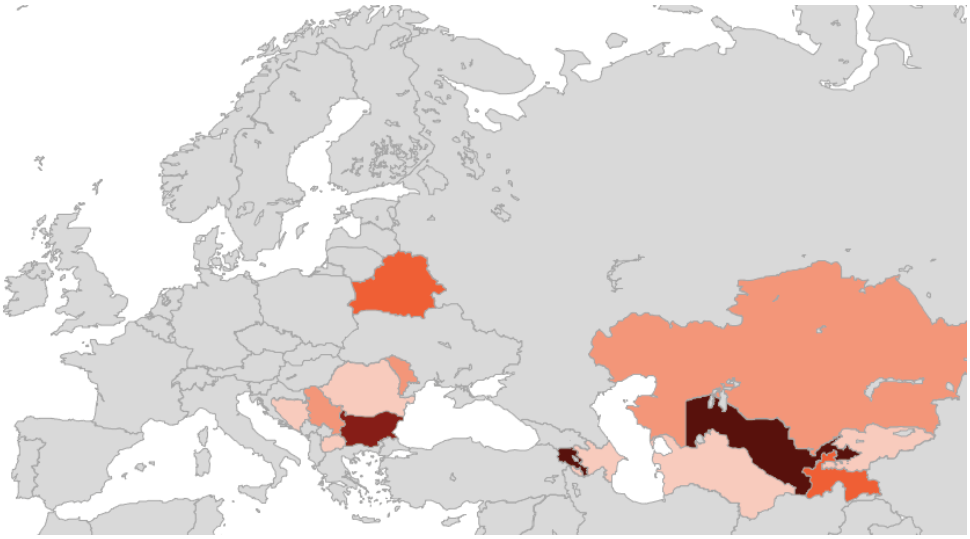
Accordingly, the life cycle analysis leads to the following conclusions:

1. Natural gas allows to decrease GHG emissions and get rid of the most harmful substances absorbed by particulate matter.
2. The use of biogas from municipal and agricultural waste allows to address environmental concerns comprehensively.
3. The transition to e-mobility implies a mandatory change in the power mix, while the transition to NGV does not require investments in power generation.
4. It is worth conducting a detailed analysis of transport transition models in each country, taking into account the prospects for energy sector development.

The Stage of Development of NGV Markets in UNECE Countries

Target countries differs substantially in terms of economic development, transport market shape, energy and transport policy. Their backgrounds in natural gas deployment in energy and fuel sector considerably differ as well.
The main indicators for NGV market are the number of filling stations and vehicles using natural gas as a motor fuel.

Figure 6. Number of CNG filling stations in UNECE countries



NGV markets in the target countries can be divides into 3 groups:

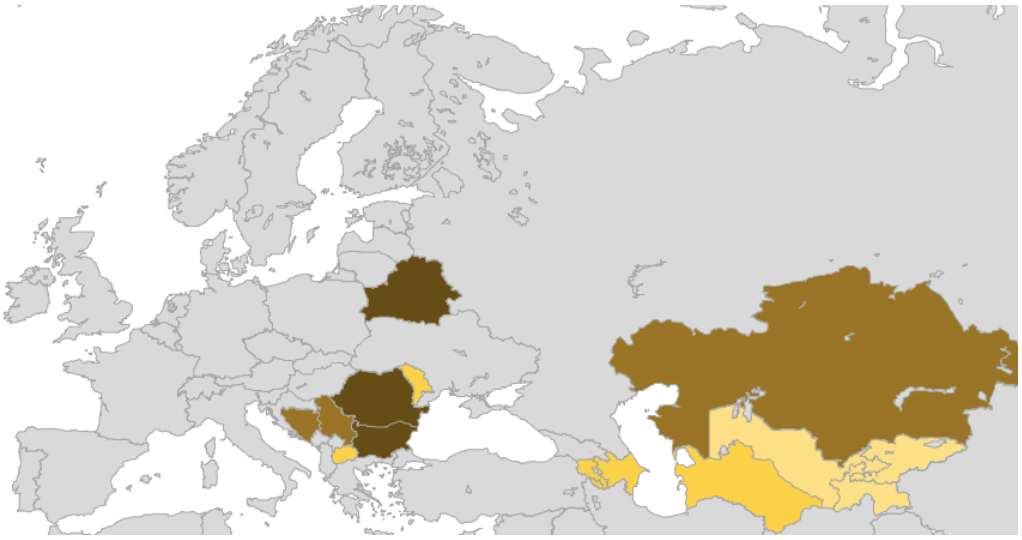
- Initial stage of the NGV market development (Azerbaijan, Bosnia and Herzegovina, Kyrgyzstan, North Macedonia, Romania, Turkmenistan);
- Emerging NGV markets (Belarus, Bulgaria, Kazakhstan, Moldova, Serbia, Tajikistan);
- Mature NGV markets (Armenia and Uzbekistan).

By initial stage of development, we mean that the number of CNG stations is less than 10 and the dynamics of NGV fleet is quite low. Further analysis of these countries primarily focuses on key barriers to market development.
Emerging market implies a greater number of stations, from 10 to 100. The conditions for successful NGV market development at this stage are quite promising.
Mature NGV market is characterized by a high level of saturation with filling stations and low potential for further growth. Guidelines for mature markets mostly focus on the question of safety and CNG cylinders circulation control.

NGV market development potential depends on the level of motorization. The following figure illustrates the variety of motorization levels for UNECE countries. The numbers vary from 37 vehicles per 1,000 inhabitants (Tajikistan) to 393 vehicles per 1,000 inhabitants (Bulgaria). Belarus, Bulgaria and Romania have the greatest potential for NGV market development in terms of volumes.

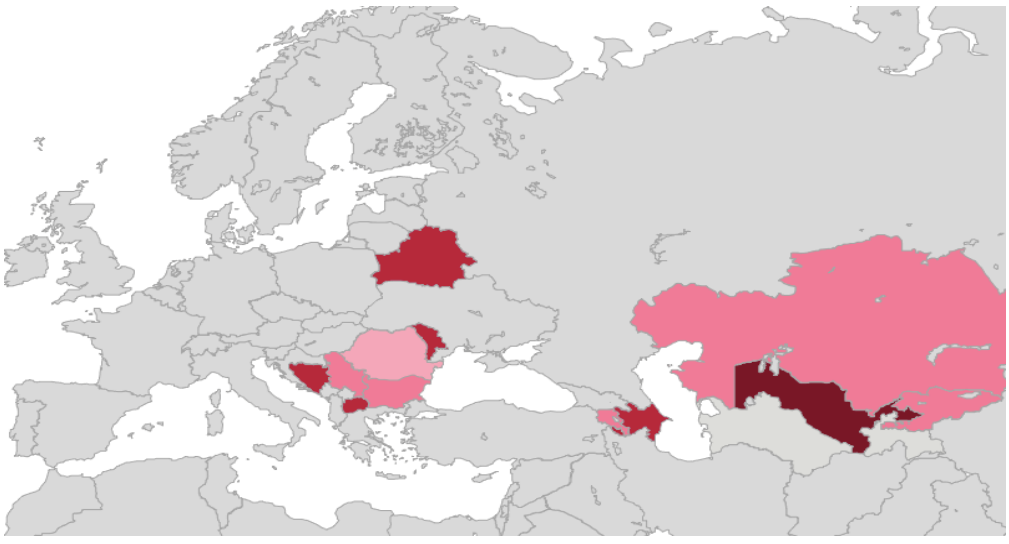
On the other hand, countries with comparatively low motorization (e.g. Azerbaijan) can be an attractive platform for an accelerated transition to the use of natural gas as a motor fuel.

Figure 7. Motorization rate



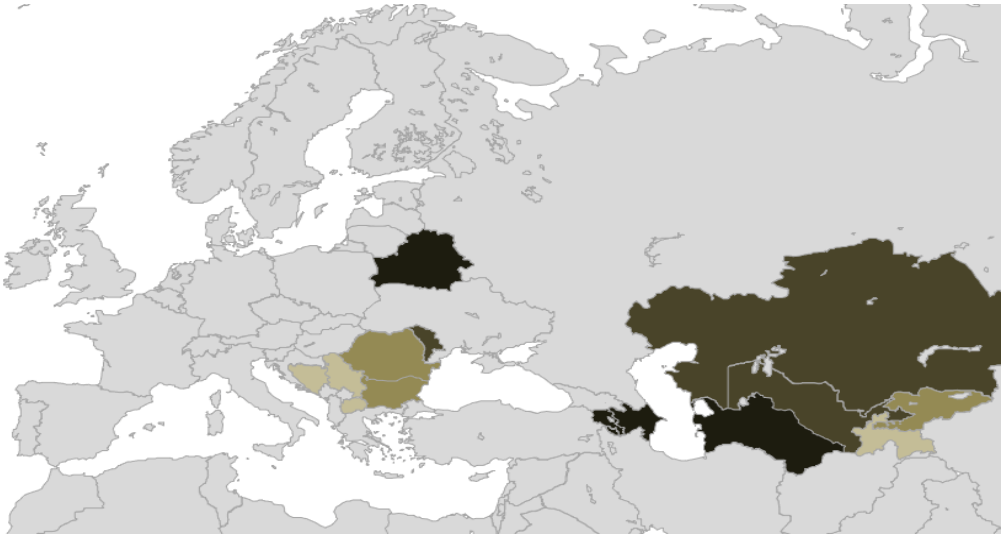
Price analysis for all target countries shows that natural gas allows to reduce the fuel cost by 20-60%. The use of CNG fuel reduces costs significantly for vehicle owners. According to the price analysis the most perspective NGV markets (with the largest economical effect from the transition to NGV) are Belarus, Moldova, Azerbaijan and Uzbekistan. Private enterprises in those countries have the strongest development potential as the potential price margin in these countries is most likely to stimulate the development of private enterprises.
In some countries LPG prices are lower than CNG prices (for example, Bulgaria and Romania). This can be a strong barrier for NGV market development. For such countries it is worth focusing on specific pilot projects in selected segments of the transport sector (e.g. water transport).

Figure 8. CNG/gasoline price difference



One more important factor for NGV market development is an access to natural gas and the rate of natural gas network coverage. The higher is the rate, the better are the terms for CNG infrastructure development.
Low natural gas network coverage means that there is a potential effective usage of small-scale LNG for the transport transition (Serbia, Bosnia and Herzegovina, North Macedonia).

Figure 9. Natural gas network coverage



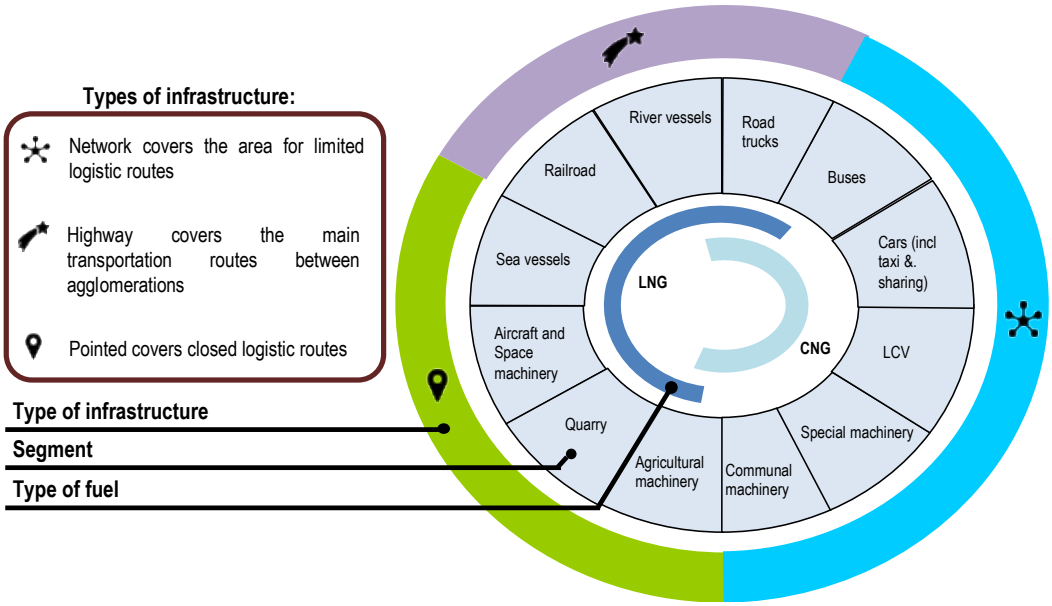
Belarus, Azerbaijan, Turkmenistan, Kazakhstan and Moldova have the best terms for CNG infrastructure development.

From an environmental point of view the following countries demonstrate the highest carbon intensity of road transport:

- Bosnia and Herzegovina,
- Serbia,
- North Macedonia,
- Moldova,
- Kyrgystan.

These countries need a quick and effective mechanism of transport transition. NGV market can be a virtuous solution.

Figure 10. Types of fuel and structure of transport sector



One more important point to be mentioned is the difference between CNG and LNG and their potential in different segments of the transport sector. While CNG is effective for buses, LCV, taxi etc (inner city area), LNG is effective for long-distance trucks, and some other types of transport and off-road machinery with high fuel consumption.

Countries with international transit routes have a great potential for small-scale LNG market development. This point should be covered in detail at the next stage of the project "Improving capacities of the UNECE member States to decarbonize the transport sector by increasing the use of natural gas as a motor fuel".

The following information is represented below:

- Summary of statistical indicators,
- Fuel prices' analysis,
- Country profiles.

Country profiles include:

1. Factsheet or general statistical information about the country and its energy, transport and fuel markets;
2. General information on the economic situation, SDGs and climate regulation, decarbonization goals for the energy, fuel, and transport sectors;
3. Governmental regulation and market mechanisms for the development of NGV market;
4. Guidelines for policy makers for the further development of NGV market in the country.

Table 2. Statistics in UNECE countries

COUNTRY	Population, thousand people	GDP per capita, $	UN HDI	Role in the Natural gas market	Natural gas network coverage, %	Motorization, Quantity per 1000 inhabitants	Vehicle fleet, thousand	Natural gas vehicles share, %	CNG stations	Carbon intensity of road transport energy consumption, gr/MJ
Armenia	2,957	14,257	81	Importer	96	110	350	80	400	61.3
Azerbaijan	10,023	15,041	88	Net exporter	96	119	1,170	-	6	71.1
Belarus	9,466	19,997	53	Net importer	97	334	3,159	0.03	42	71.7
Bosnia and Herzegovina	3,301	15,883	73	Net importer	limited	263	920	-	2	72.8
Bulgaria	6,975	24,789	56	Importer	30	393	2,773	2	121	67.5
Kazakhstan	18,513	27,517	51	Net exporter	52	209	3,847	0.04	10	69.3
Kyrgystan	6,456	5,485	120	Net importer	0-52	..	..	..	6	72.1
Moldova	2,640	13,627	90	Net importer	20-90	173	616	0.7	14	72.2
Romania	19,356	32,297	49	Net importer	15	330	6,452	-	3	69.2
North Macedonia	2,083	17,607	82	Importer	limited	194	415	-	6	72.4
Serbia	6,944	19,013	64	Net importer	limited	252	1,715	-	24	72.6
Tajikistan	9,321	3,529	125	Importer	limited	37	300	-	53	72
Turkmenistan	5,942	15,207	111	Exporter	99	107	850	-	-	71.2
Uzbekistan	33,580	7,308	106	Exporter	85/77	70	2,272	-	1,070	63.4

Table 3. Fuel prices analysis and average savings calculation

COUNTRY	Average price, USD				% Savings from shifting to CNG			Estimated average savings per year, $	
	CNG	Gasoline	Diesel	LPG	Gasoline	Diesel	LPG	Gasoline /CNG	Diesel / CNG
Armenia	0.46	0.692	0.65	0.29	-33.9%	-29.7%	56.0%	1,020.8	660
Azerbaijan	0.265	0.588	0.471	0.382	-54.9%	-43.7%	-30.6%	1,040.2	571
Belarus	0.304	0.693	0.693	0.358	-56.1%	-56.1%	-15.1%	1,237.6	960.4
Bosnia and Herzegovina	0.65	1.18	1.165	0.655	-44.9%	-44.2%	-0.8%	1,922	1,420
Bulgaria	0.814	1.112	1.113	0.562	-26.8%	-26.9%	44.8%	1,529.2	1,086.4
Kazakhstan	0.24	0.401	0.435	*no data*	-39.4%	-44.2%	-	622.4	530
Kyrgyzstan	0.33	0.459	0.447	0.3	-28.4%	-26.5%	9.5%	641.6	434
Moldova	0.463	1.04	0.846	0.588	-55.5%	-45.3%	-21.3%	1,847.8	1,043.8
North Macedonia	0.628	1.197	1.02	0.638	-47.5%	-38.4%	-1.6%	1,993.6	1,160.8
Romania	1.034	1.225	1.228	0.645	-15.6%	-15.8%	60.3%	1,492.4	1008.4
Serbia	0.88	1.433	1.515	0.811	-38.6%	-41.9%	8.5%	2,207.2	1,798
Tajikistan	..	0.73	0.79	..	..	..	..	..	..
Turkmenistan	..	0.429	0.386	..	..	..	..	..	..
Uzbekistan	0.29	0.747	0.571	-	-61,8%	-50.0%	..	2,892.1	1,224.3

Country Profiles

Initial stage of the NGV market development


Bosnia and Herzegovina


Azerbaijan


Kyrgyzstan


North Macedonia


Romania


Turkmenistan

Emerging NGV market


Belarus


Bulgaria


Kazakhstan


Moldova


Serbia


Tajikistan

Mature NGV market


Armenia


Uzbekistan

Armenia

Factsheet

2,957 Population, thousand people	**111** Motorization rate, vehicles per 1000 people	**1.8** Carbon intensity, tonnes CO_2-eqv per capita	**91** Human Development Index
350 Vehicles fleet, thousand	**0.2** Carbon intensity, CO_2 per GDP, kg/USD	**14,258** GDP per capita PPP, $	**80** Natural gas vehicles share, %
61 Carbon intensity of road transport energy consumption, gr/MJ	**96** NG network coverage, %	**96** NG fuel stations	**28** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Armenia in the main is a mountainous country, without access to sea. Despite a high level of industrial development, the unemployment rate is quite high, and a significant part of disposable income comes from labor of emigrants abroad. According to the UN Human Development Index classification Armenia ranks the 81st and belongs to the second group, the group with a high level of development. The GDP per capita at PPP is $14,258.

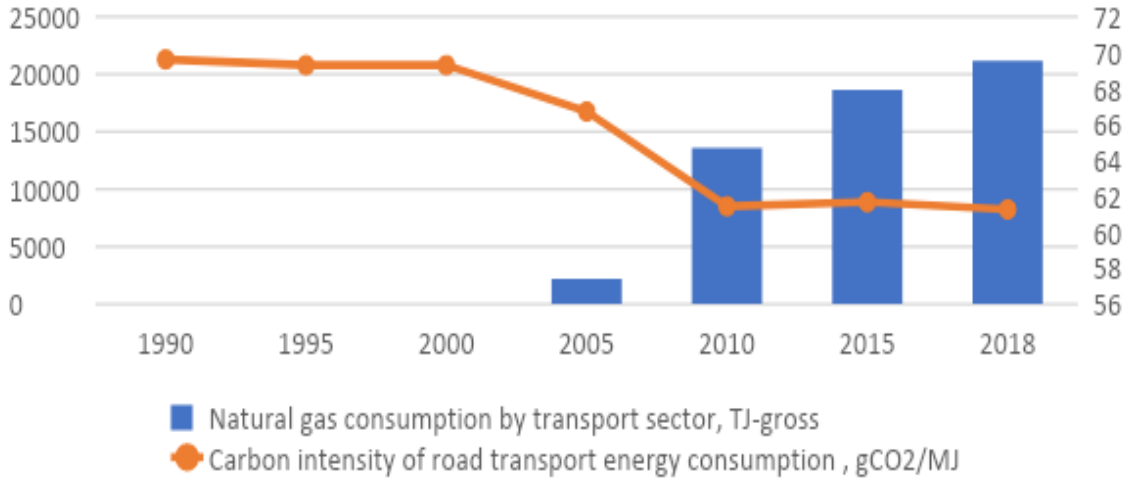
Armenia joined the UN Framework Convention on Climate Change in 1993 and subsequently ratified the Kyoto Protocol and the Paris Agreement.
Within the framework of its commitments under the Paris Agreement, Armenia has pledged to promote the principles of green economy and limit GHG emissions.
The commitments have to do with the development of renewable energy and improving the energy efficiency of the economy. As for the implementation of climate and environmental goals in the transport sector, it is stated that Armenia will strive to reduce the carbon intensity of the transport segment, in particular by transport electrification.
Along with the transition to NGV, there are also several other electrification programs. In particular, Yerevan supports the development of trolleybus fleet. Owners of EVs get tax incentives.
At the regional level, the country has several programs to reduce GHG emissions, such as:

- The partnership of the mayors of cities of East and Central Asia, who have set goals to reduce GHG emissions by 20 % by 2020 and by 30% by 2030, compared to 2010 levels.
- Within the framework of the Green city project (GrCF2), "Yerevan bus project" expands the fleet of city buses[7], and the national postal operator of Armenia expands the fleet of CNG trucks for post offices.

The energy mix of Armenia is formed by 55% of natural gas, 18% by nuclear energy, and 5% by hydropower. Armenia is an importer of natural gas. The first deliveries of natural gas started in the 1960s; during this period, the natural gas network coverage reached 96%[8].
The main suppliers of natural gas are Russia (80%), and Iran (20%). It is expected that this resource will be ever more important for the country due to the planned phase out of the Armenian nuclear power plant in 2026.

The low level of carbon intensity of transport (61 gr/MJ), indicates a fairly high environmental efficiency of the transport sector.
The development of the NGV market has allowed not only to solve significant socio-economic problems but also to reduce the emission in the transport segment and thereby achieve some of the world's best indicators for CO_2 intensity in the transport sector.

Figure 11. Gas consumption and carbon intensity of transport sector in Armenia



Source: International Energy Agency

Governmental regulation and market mechanisms

Armenia is one of the leaders in the share of NGV transport. The NGV market began to develop actively in Armenia in 1990s due to low disposable income and lack of petroleum and diesel fuels. Natural gas supply was sustainable and the price of natural gas was 2.5 times lower than that of petroleum. These factors led to a massive conversion of private cars to CNG.
The NGV market developed as a free market, with numerous small enterprises in CNG sales, services, equipment production. In 1998-2011 the corporate development program of Gazprom Armenia facilitated its development.
Within 20 years, the country has developed a mature NGV market with the following indicators:

- 80% of the national fleet, or 250,000 vehicles, use natural gas as a motor fuel.

- Monthly sales of natural gas as a motor fuel amount to over 500 million cubic meters, accounting for 25% of the country's gas consumption.
- There are 400 CNG filling stations in Armenia, the maximum distance between the stations is 25 km.
- Complementing products and services for CNG filling stations and gas cylinder equipment have been developed.
- The market is fully liberalized. The share of the main gas supplier (Gazprom Armenia LLC) is less than 1%.

There is no special governmental program for the development of the NGV market in Armenia. Nor has the country any technical regulations for the CNG filling stations and gas cylinders certification/verification process.

Guideline for Armenia

The role of natural gas as an energy resource in Armenia will increase, which is pivotal for the sustainable development of the energy and transport sectors of Armenia.

The country's absolute GHG emissions are among the lowest in the world. With the current and prospective structure of the fuel and energy mix, the use of natural gas in the transport sector is both economically and environmentally advantageous.

The development of EV transport will require additional substantial investment in renewable energy technologies and EVs. Taking in consideration the current socio-economic situation of the country, expensive e-projects are unlikely to be appropriate.

To support the free-market model it is necessary to develop a framework for CNG filling stations' safety and CNG cylinders turnover regulations.

The level of motorization in Armenia is 111 units per 1000 inhabitants, thus, there is sufficient room for strengthening its vehicle fleet. Active promotion of natural gas as a motor fuel will allow consumers to make a rational choice.

Azerbaijan

Factsheet

10,000 Population, thousand people	**118** Motorization rate, vehicles per 1000 people	**3.1** Carbon intensity, tonnes CO_2-eqv per capita	**88** Human Development Index
1,170 Vehicles fleet, thousand	**0.2** Carbon intensity, CO_2 per GDP, kg/USD	**15,041** GDP per capita PPP, $	**-** Natural gas vehicles share, %
71 Carbon intensity of road transport energy consumption, gr/MJ	**96** NG network coverage, %	**6** NG fuel stations	**25** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Azerbaijan is located on the Caspian Sea. Due to the mostly mountainous landscape, accessible regions of the country are densely populated. About 20% of the population lives in or near Baku.
In the end of the XX century Azerbaijan, like many post-Soviet countries, has gone through a deep socio-economic crisis. As a result, 45% of its population found themselves below the poverty threshold.
The main driver of economic growth was the oil and gas industry that has become the source of capital for other industries.
Azerbaijan belongs to the group of developing countries, according to the UN Human Development Index classification the country ranks the 88th and belongs to the second group, the group with a high level of development. The GDP per capita on PPP is $15,041.

Azerbaijan joined the UN Framework Convention on Climate Change in 1995 but did not join the Kyoto agreement. In 2015 Azerbaijan ratified The Paris Agreement. Within the framework of its commitments under the Paris Agreement, Azerbaijan has pledged to reduce GHG emissions by 35% as compared to 1990 levels.
Taking into account the urgency of the global climate change agenda, the government of Azerbaijan declares its goals in state programs and documents including an increase of renewables in energy mix up to 30% by 2030. The development of renewables is planned based hydro, as well as solar and wind generation.
Upgrading of power plants and pipelines, electrification of the road transport and railways are intended to ensure the energy efficiency in the country. Global climate goals coincide with national economic and environmental goals. Reducing transport

emissions is important for improving the environmental situation in densely populated areas.
It is planned to electrify public transport, railway communication, and develop the tube. In some cases, public transport was switched to natural gas.
Azerbaijan is a net exporter of natural gas and oil. Oil accounts for about 35% of the energy mix, while natural gas accounts for over 60%. Electricity is generated from natural gas (95%) and hydro power plants (5%).
Intensive (30% growth) development of gas distribution networks in the last 10 years allowed to cover 96% of the country.
The transport sector mainly uses traditional petroleum fuels, 99% of cars use gasoline and diesel.
National auto fleet is about 1.2 million, 60% of motor transport is concentrated in Baku. The level of motorization is 118 cars per 1000 inhabitants. The vehicle fleet grew by 200% as compared to 1998. A sharp increase in motorization due to mostly outdated car models the average age of which is more than 10 years) has exacerbated the problem of local environmental pollution. The GHG transport sector increased 4 times, from 2 million to 8 million tons of CO2. The transport sector accounts for 25% of all country emissions.
With a further increase in the welfare of the population, we can expect a growth of the country's automobile fleet by another 2-3 million units, which will increase the urban air pollution in the region.
In response to environmental problems in the country, the requirements for vehicle fleet emissions became more strict, Euro-4 class standards were introduced in 2010, and there are restrictions on the import of cars below Euro-4 class. Automobile fuel needs are met by two refineries that also export their products abroad. In 2019 the capacities of oil refineries to produce Euro-5 gasoline (2019) were upgraded.
Taking into account the relatively low level of disposable income, it is the transition to NGV, not to e-mobility, that is preferable for Azerbaijan.

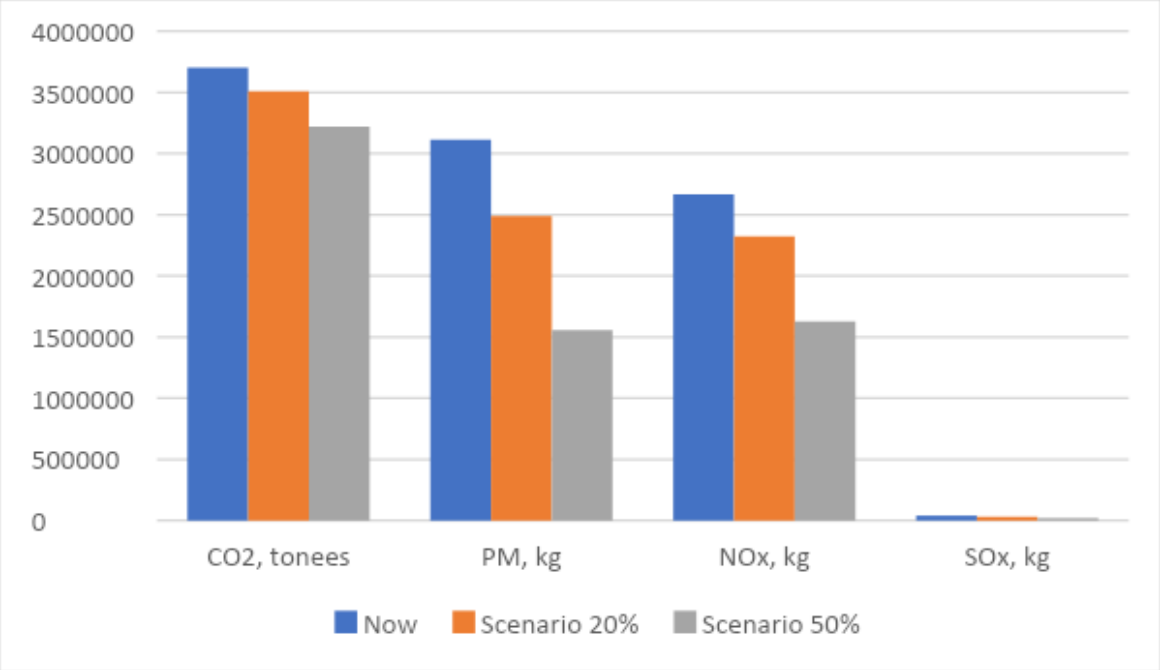
Governmental regulation and market mechanisms

In its National climate commitments Azerbaijan emphasizes the importance of developing eco-friendly transport and prioritizes reducing emissions in the transport sector.
Azerbaijan has joined the ITF Decarbonizing Transport in Emerging Economies (DTEE) project for the period 2020-2021[3], which helps developing economies reduce their CO_2 emissions and achieve climate goals. A model for decarbonizing the transport sector should be developed in 2021.
National policy documents specify goals for electrification of public transport. At the same time many governmental initiatives were announced to develop the NGV market in 2013-2015. In particular, in 2015 the state-owned company SOCAR announced its intention to build 6 CNG filling stations in the suburbs of Baku. At the present time, 6 CNG filling stations operate throughout Azerbaijan, 1 of which belongs to SOCAR, 1 to Gazprom, 4 to independent market participants.
In 2020 it was decided to shift bus lines in Baku to compressed natural gas.

Life cycle analysis

The figure 12 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is 2.8 bcm
The potential annual demand for natural gas in 50%-Scenario is 3.5 bcm

Figure 12. Transport transition scenarios, Azerbaijan



Source: NGVA Russia estimation

Guideline for Azerbaijan

Reducing the emission profile of the transport sector is of great importance for Azerbaijan, as it accompanies the company's economic, environmental and climate challenges and commitments.
Current price of CNG in Azerbaijan is 55% less than gasoline prices, thus making it quite attractive for potential customers.
The gas network coverage is 96% that allows to develop CNG filling stations network.
Gas station infrastructure is also perspective for transit transport due to plans of international highways development. Taking into account the neighboring NGV markets (Dagestan region of Russia and Iran) the project of Iran–Azerbaijan–Russia, CNG corridor is expected to be highly perspective.
The next step is to create a layout of gas filling stations and objects of supporting infrastructure (cylinder inspection centers, service centers, retrofitting points etc).

The layout should be based on the potential demand research for different segments of the transport sector:

a. Private cars
b. Taxi
c. Buses
d. LCVs
e. Trucks
f. Water transport
g. Railway transport
h. Quarry machinery
i. Construction, communal and agricultural machinery

The number of the gas station infrastructure objects is to be calculated based on the results of the demand analyses. Whenever possible the gas station infrastructure objects should be located near highways and have access to gas networks. Then the need for supporting infrastructure should be estimated.

The required investments and potential socio-economic and environmental effects of the NGV market can only be assessed after all potential locations for infrastructure facilities are determined. At the last stage, additional state support measures will be worked out.

Belarus

Factsheet

9,466 Population, thousand people	**334** Motorization rate, vehicles per 1000 people	**6** Carbon intensity, tonnes CO_2-eqv per capita	**53** Human Development Index
3,159 Vehicles fleet, thousand	**0.3** Carbon intensity, CO_2 per GDP, kg/USD	**19,997** GDP per capita PPP, $	**0,3** Natural gas vehicles share, %
71.7 Carbon intensity of road transport energy consumption, gr/MJ	**97** NG network coverage, %	**42**[1] NG fuel stations	**28** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Most of the Belarus territory is located on the plane, without access to the sea. The country has developed an industrial cluster, including a group of NG vehicles manufacturers and CNG cylinders producers.
According to the UN Human Development Index classification Belarus ranks 53rd and belongs to the group with the highest level of development. The GDP per capita at PPP is $ 19,997. Belarus belongs to developing countries.

Belarus joined the UN Framework Convention on Climate Change in 1992, in 2005 the country signed the Kyoto Agreement, in 2015 Belarus ratified the Paris Agreement.
According to the NDC, Belarus plans to reduce air emissions by 28% by 2030 compared to 1990. Belarus announced its intentions to proceed with socio-economic development of the republic based on the principles of green economy and its desire to thereby limit the growth of emissions and contribute to their reduction. The document refers to the development of renewable energy sources, and transition to e-mobility.
The NDC also talks about reducing emissions in the energy sector, industry, agriculture, and waste processing. Transport, which accounts for 20.5% of the country's greenhouse gas emissions, is not mentioned.

Natural gas accounts for 65% of fuel and energy balance of Belarus. Belarus is a net importer of natural gas. The main supplier is Russia.
Electricity generation until 2021 was 100% based on natural gas. In 2021, the Belarusian Nuclear power plant was put into commercial operation; it will change the power mix and create the energy surplus.
Almost all territory of the country is covered by gas distribution network, in 2020 the coverage amounted to 97%.

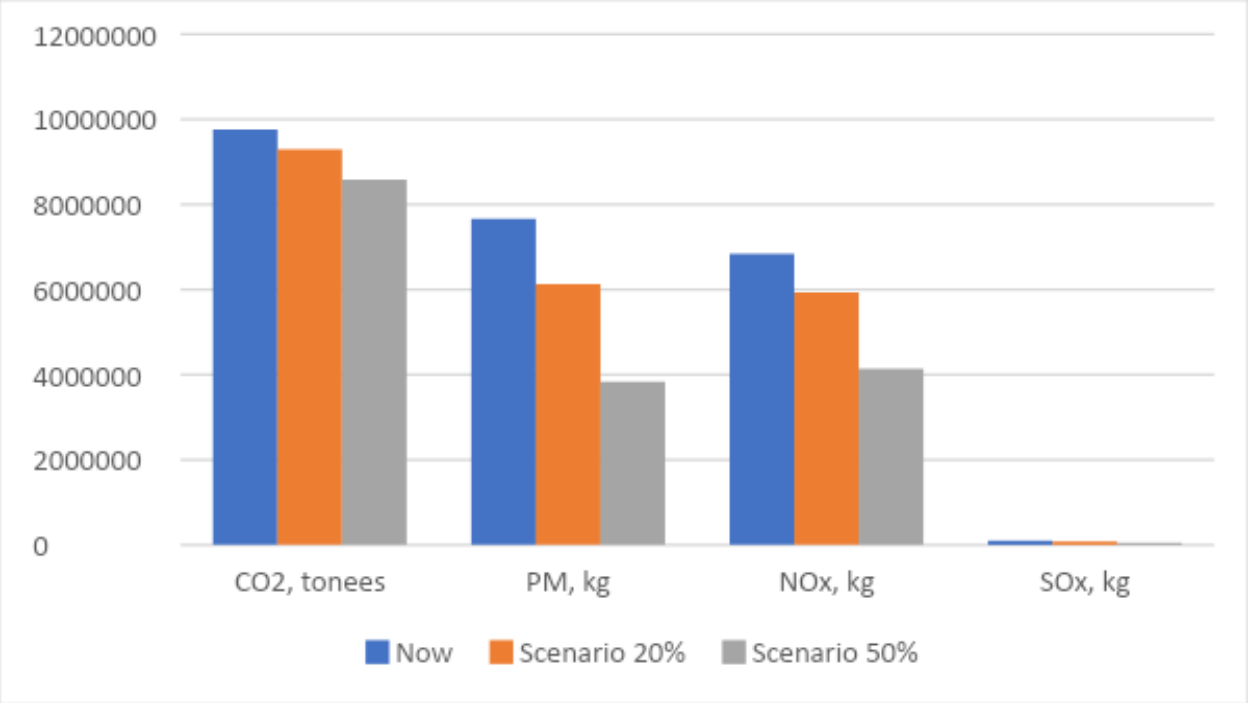
Governmental regulation and market mechanisms

Since 2010, the country has been actively discussing initiatives and implementing programs for the transition to NGV. In 2013, the Government of Belarus and PJSC Gazprom signed the Program for converting public transport and communal machinery to natural gas. The program provides for CNG cylinders manufacturing, NGV production and CNG filling stations construction.
In 2014 PJSC Gazprom and OJSC Gazprom Transgaz Belarus signed the roadmap. The roadmap action plan for the period up to 2016 provided for active interaction with the authorities on incentive mechanisms for NGV fleet growth, and cooperation with vehicle manufacturers to develop the production of gas-cylinder equipment. Thus, the construction of gas gas station infrastructure facilities was synchronized with the programs for launching NGV vehicles on the market.
In the first stage of the program 28 CNG stations were built, and several mobile fillers for filling remote users were purchased. The capacity of the gas station infrastructure is 165 million m^3 of natural gas, which roughly corresponds to the needs of 18,000 vehicles.
By 2020, the NGV fleet reached just over 10,000 units, which is 0.3% of the transport in Belarus. Gas found the greatest distribution in the largest cities - Minsk and Brest. The main consumer groups include taxi services and public transport.
In 2019, prices for oil products in the Republic of Belarus increased, thus accelerating transfer of personal vehicles to natural gas.
Models of specialized equipment of a wide profile are mass-produced or are at the stage of experimental production, starting from passenger city buses, municipal equipment and up to agricultural equipment. Currently, several large plants in Belarus produce methane-fueled transport equipment: MAZ, MTZ, BELAZ, Gomselmash, OJSC Novogrudok Gas Equipment Plant (NOVOGAS), Cilinders-Bel LLC, etc. There are also some joint projects with Russian and European car manufacturers.

Life cycle analysis

The figure 13 offers 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is 7.5 bcm.
The potential annual demand for natural gas in 50%-Scenario is 9.2 bcm.

Figure 13. Transport transition scenarios, Belarus



Source: NGVA Russia estimation

Guideline for Belarus

Belarus demonstrates a comprehensive approach to the NGV market development that involves the gas distribution network expansion, the development of gas station infrastructure and services and promotion of natural gas as a motor fuel among the potential customers.

Now the country has all basic conditions for the progressive development of the market. The next step is to create a layout of gas filling stations and objects of supporting infrastructure (cylinder inspection centers, service centers, retrofitting points etc). The layout should be based on the analyses of potential demand for different segments of the transport sector:

a. Private cars
b. Taxi
c. Buses
d. LCVs
e. Trucks
f. Water transport
g. Railway transport
h. Quarry machinery
i. Construction, communal and agricultural machinery

The number of the gas station infrastructure objects is to be calculated based on the results of the demand analyses. Whenever possible the gas station infrastructure objects should be located near highways and have access to gas networks. Then need for supporting infrastructure should be estimated.

The required investments and potential socio-economic and environmental effects of the NGV market can only be assessed after all potential locations for infrastructure facilities are determined. At the last stage, additional state support measures will be worked out.

Bosnia and Herzegovina

Factsheet

3,301 Population, thousand people	**263** Motorization rate, vehicles per 1000 people	**6.7** Carbon intensity, tonnes CO_2-eqv per capita	**73** Human Development Index
920 Vehicles fleet, thousand	**0.5** Carbon intensity, CO_2 per GDP, kg/USD	**15,883** GDP per capita PPP, $	**no data** Natural gas vehicles share, %
72.8 Carbon intensity of road transport energy consumption, gr/MJ	**up to 26%** NG network coverage, %	**3** NG fuel stations	**14** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Bosnia and Herzegovina is a country with a predominantly mountainous terrain, located on the Balkan Peninsula.
According to the UN Human Development Index classification, Bosnia and Herzegovina is in 73rd place and belongs to the second group of developed countries. The GDP per capita at PPP is $15,883. The country is a potential candidate for EU.

Bosnia and Herzegovina joined the UN Framework Convention on Climate Change in 2000. In 2007, the country ratified the Kyoto Protocol, and in 2017 the Paris Agreement was ratified. For the stated purposes, Bosnia and Herzegovina announce the development of renewable energy sources, wind, and solar energy.

The local coal production is 55% of the energy mix of the country, oil is about 20%, and the share of natural gas does not exceed 3%.
Bosnia and Herzegovina is a net importer of all types of energy resources. Natural gas is supplied to the country from Russia mostly for industrial needs.

The carbon intensity of Bosnia and Herzegovina is 6.7 tons per person, and the carbon intensity of the transport sector is 72.8 gr/MJ. Both rates are higher than average in EU.
The gas network coverage is low. At the same time, many projects are underway to develop the gas transportation infrastructure, for example, its integration with the Croatian gas transportation system.

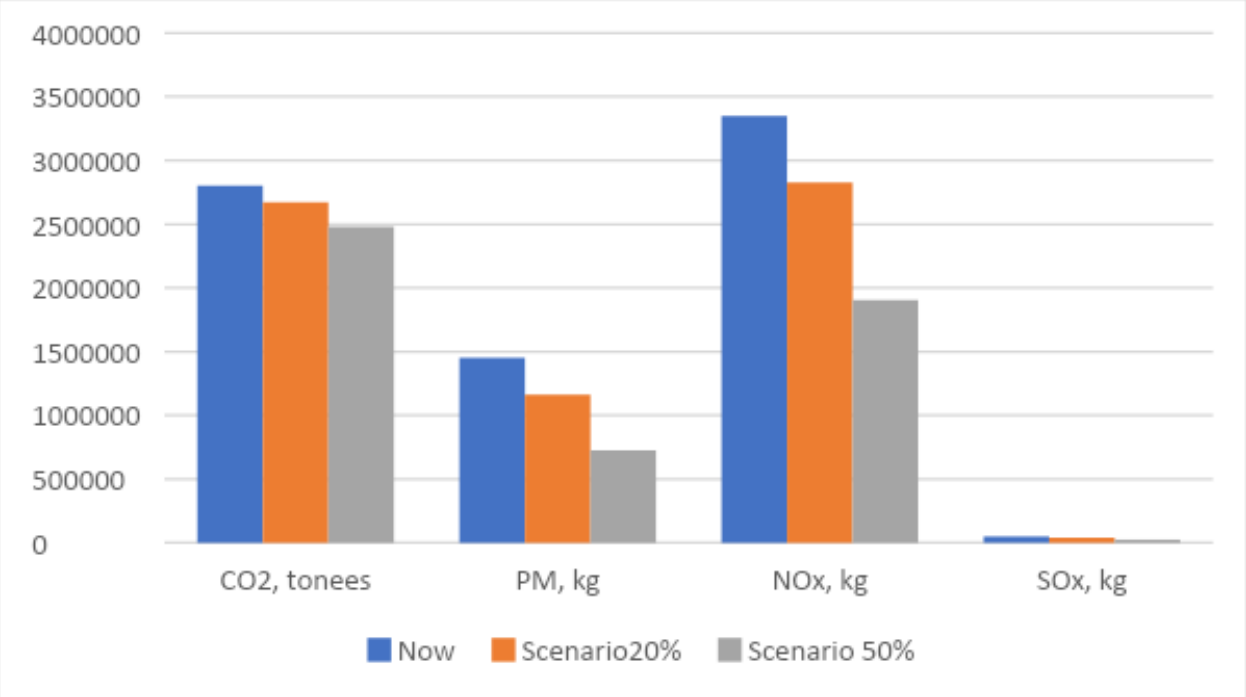
Governmental regulation and market mechanisms

There are currently no state programs for the development of the NGV market in Bosnia and Herzegovina, even though natural gas has price advantages: natural gas is 45% cheaper than gasoline. This is the key incentive for the perspective market development.
But the current market is quite limited: there are only 3 CNG filling stations in the country.

Life cycle analysis

The figure 14 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is 2.2 bcm.
The potential annual demand for natural gas in 50%-Scenario is 2.8 bcm.

Figure 14. Transport transition scenarios, Bosnia and Herzegovina



Source: NGVA Russia estimation

Guideline for Bosnia and Herzegovina

The power mix of the country is mostly based on coal. Without significant investments in power sector, BEV implementation will only worsen indicators of greenhouse gas emissions. Full lifecycle analysis of BEV's perspectives is possible in case of modeling of long-term energy sector structure development.
Taking into account the high level of carbon intensity and the difference between the prices of natural gas and petroleum fuel, there are fundamental request for the NGV market development.

The main barrier to the NGV market development is low coverage of gas distribution network. In these conditions, it is advisable to consider the possibility of creating an infrastructure for small-scale LNG and start transition from the commercial segments of transport sector, primarily long-distance heavy trucks and machinery. CNG for taxi, LCV and individual cars segments can be obtained by LNG regasification.

It is recommended to consider the possibility of a pilot project in the field of small-scale LNG for trucks, mainline bus transport and quarry machinery.

Bulgaria

Factsheet

6,975 Population, thousand people	**334** Motorization rate, vehicles per 1000 people	**5.7** Carbon intensity, tonnes CO_2-eqv per capita	**56** Human Development Index
2,773 Vehicles fleet, thousand	**0.3** Carbon intensity, CO_2 per GDP, kg/USD	**24,789** GDP per capita PPP, $	**2** Natural gas vehicles share, %
67.5 Carbon intensity of road transport energy consumption, gr/MJ	**no data** NG network coverage, %	**121** NG fuel stations	**20** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Bulgaria is located on the Black Sea coast. According to the UN Human Development Index classification Bulgaria ranks 56th p and refers to countries with a very high level of development. According to the UN classification, it belongs to countries with a developed market economy. The GDP per capita at PPP is $ 19,997.

Bulgaria joined the United Nations Framework Convention on Climate Change in 1994 and ratified the Kyoto Protocol in 2002. Bulgaria signed the Paris Agreement in 2016. As a member of the European Union Bulgaria pledges to reduce emissions by 2030 compared to 1990 by 55% and to reach carbon neutrality by 2050.

The energy mix is 30% coal, 20% nuclear energy, 20% oil. The share of natural gas in the energy balance is not higher than 15%, thermal power industry is not more than 10% either. Main resources for generating electricity are nuclear energy and coal. The main GHG emitters are the heat, power, and transport sectors.

Natural gas is used by more than 60 thousand cars, 280 buses, 40 natural gas trucks in Bulgaria. There are 121 CNG stations in the country. LPG is more competitive and widespread, as is used by more than 200 thousand automobiles.

Governmental regulation and market mechanisms

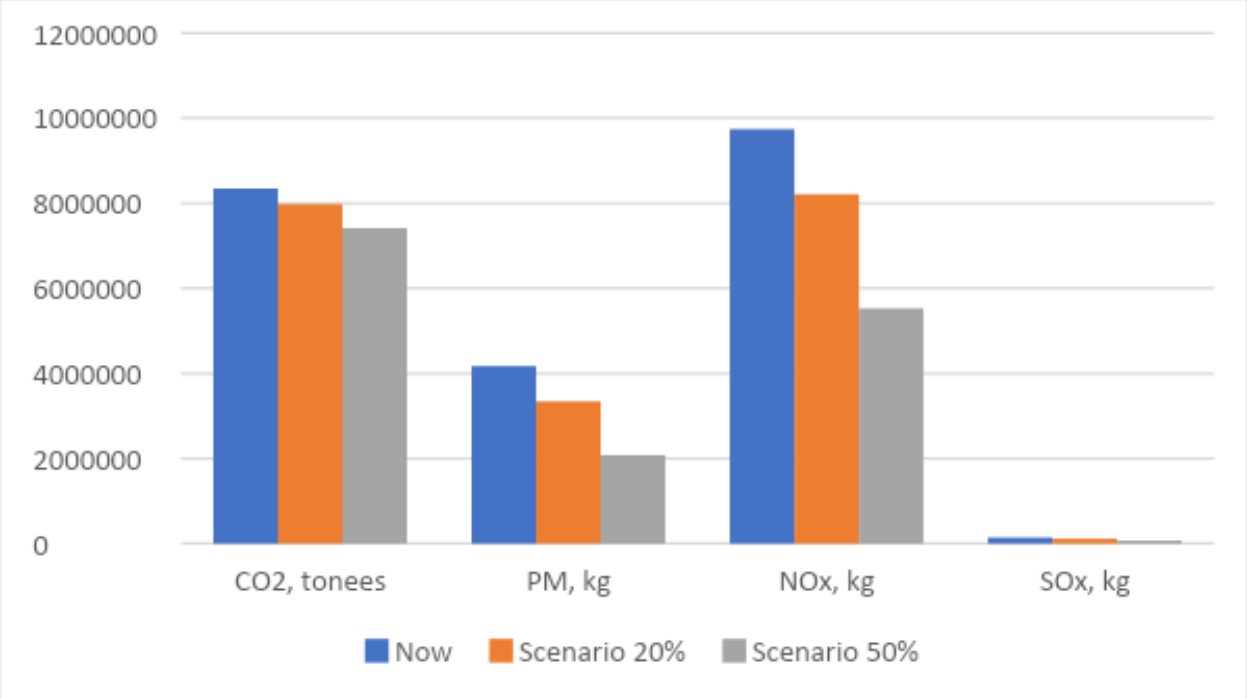
Following Directive 2014/94 on the development of infrastructure for alternative fuels, EU states are obliged to set national targets for the infrastructure deployment for recharging EVs in urban and suburban areas and refueling vehicles with natural gas in urban and suburban areas and the TEN-T core network.

Per the Directive, the country plans to build CNG and LNG refueling complexes along the TNT-T routes, as well as the construction of LNG refueling complexes to provide fuel for inland water transport. By 2025, it is planned to build a marine refueling complex, and by 2030 - river ones.
Shift of the public transport to natural gas is being carried out in parallel. More than 200 buses in Sofia use CNG as a motor fuel. Several logistics companies and agricultural enterprises reported on the purchase of NGV equipment, trucks, tractors. CNG production for Scania trucks launched.

Life cycle analysis

The figure 15 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is 6.6 bcm.
The potential annual demand for natural gas in 50%-Scenario is 8.2 bcm.

Figure 15. Transport transition scenarios, Bulgaria



Source: NGVA Russia estimation

Guideline for Bulgaria

The large share of coal in the power mix doesn't allow to effectively implement BEV.
At the same time, the basic infrastructure for the NGV market development has already been created. There are some barriers for the further development of the NGV market: low gas distribution network coverage and low prices for LPG (natural gas is 44% more expensive).

Given the outdated vehicle fleet in Bulgaria, the average income, natural gas is the most affordable alternative to improve the environmental situation, especially in areas with heavy traffic and in segments with high fuel consumption (e.g. river and maritime transport).

The next step is to create a layout of CNG and LNG filling stations and objects of supporting infrastructure (cylinder inspection centers, service centers, retrofitting points etc). The layout should be based on the potential CNG and LNG demand research for the different segments of the transport sector (covering road, water, railway transport and off-road machinery):

a. Private cars
b. Taxi
c. Buses
d. LCVs
e. Trucks
f. Water transport
g. Railway transport
h. Quarry machinery
i. Construction, communal and agricultural machinery

. Then the requirements in supporting infrastructure should be estimated.

The number of the gas station infrastructure objects is to be calculated based on the results of the demand analyses. Whenever possible the gas station infrastructure objects should be located near highways and have access to gas networks. Then need for supporting infrastructure should be estimated.

The required investments and potential socio-economic and environmental effects of the NGV market can only be assessed after all potential locations for infrastructure facilities are determined. At the last stage, additional state support measures will be worked out.

Additional obligations to guarantee the environment protection in segments with high fuel consumption can make natural gas more attractive for final customers.

Kazakhstan

Factsheet

18,513 Population, thousand people	**209** Motorization rate, vehicles per 1000 people	**11.7** Carbon intensity, tonnes CO_2-eqv per capita	**51** Human Development Index
3,847 Vehicles fleet, thousand	**0.4** Carbon intensity, CO_2 per GDP, kg/USD	**27,517** GDP per capita PPP, $	**0.04** Natural gas vehicles share, %
69 Carbon intensity of road transport energy consumption, gr/MJ	**52** NG network coverage, %	**17** NG fuel stations	**4** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Kazakhstan is located in a steppe area with low population density. According to the UN Human Development Index classification Kazakhstan ranks 51st and belongs to a group with a very high level of development. The GDP per capita at PPP is $27,517.

Kazakhstan joined the UN Framework Convention on Climate Change in 1995 and ratified the Kyoto Protocol and the Paris Agreement in 2009 and 2016, respectively. As part of its obligations under the Paris Agreement, Kazakhstan announced its intention to reduce greenhouse gas emissions by 15% compared to 1990, or by 25%, subject to assistance from international funds.
Improving energy efficiency is one of the goals and objectives of building a green economy, which is given significant attention in the draft Strategy and low-carbon development of the economy of the Republic of Kazakhstan until 2030.

The energy mix of Kazakhstan is 50% coal, 22% natural gas and 23% oil. Electricity is generated based on coal raw materials (70%), natural gas (20%), hydro (10%). Kazakhstan is an exporter of natural gas and other hydrocarbons.

The gas networks coverage is not higher than 52% due to remotely located cities and seismicity of southern territories.
Outdated vehicle fleets is the key reason behind high GHG intensity in the transport sector. Kazakhstan has not yet implemented the Euro 4 standards neither for passenger cars nor for trucks and buses.
Nevertheless, the GHG intensity of heat and industry is much higher, so the transport sector emissions account for about 4%.

Governmental regulation and market mechanisms

In recent years, Kazakhstan started to adopt a set of governmental programs to reduce the GHG emissions, which can have a significant impact on the development of the NGV market. Air pollution in some cities of Kazakhstan is hazardous and dangerous, so any decisions on fighting local pollution will be welcomed.

The draft Low-Carbon Development Strategy provides some clauses for transport transition to NGV programs. The key document for the development of the NGV market is the Action Plan for expanding the use of natural gas as a motor fuel for 2019-2022. Document provides for energy-efficient measures in public transport and infrastructure and shift to environmentally friendly fuels. It is planned to build 100 CNG and LNG stations all over the country. LNG stations are expected to be in demand on the planned Western Europe - China route.

By 2021, 17 CNG stations will operate in Kazakhstan. There are some successful projects for bus fleet transfer to natural gas in Almaty, Shymkent, Astana.

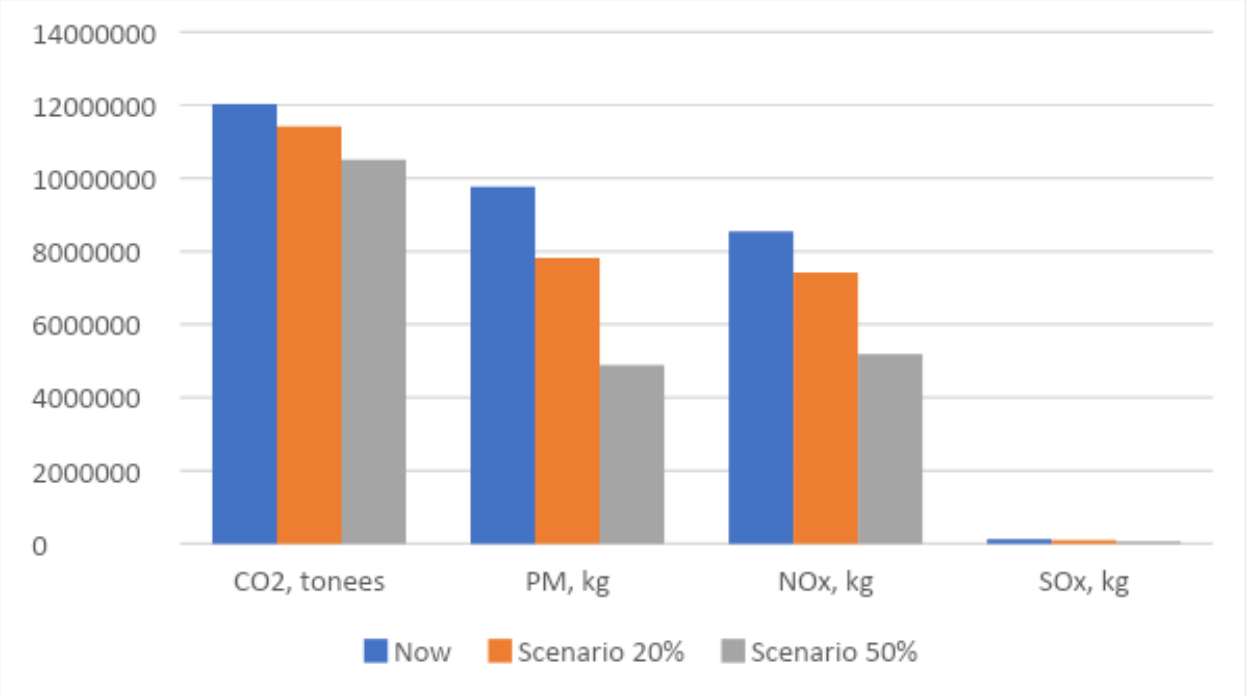
Life cycle analysis

The figure 16 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).

The potential annual demand for natural gas in 20%-Scenario is 9.2 bcm.

The potential annual demand for natural gas in 50%-Scenario is 11.4 bcm.

Figure 16. Transport transition scenarios, Kazakhstan



Source: NGVA Russia estimation

Guideline for Kazakhstan

Thus, main obstacles are limited access to natural gas in some regions as well as insufficient financing and governmental support. The further development needs complex measures for NGV promotion.

CNG is 40% cheaper than gasoline, so there is an economic incentive for market players to switch from petroleum fuels to natural gas. Hazardous air urban quality is another stimulus to shift the transport to natural gas usage.

In areas with low gas distribution network coverage it is advisable to consider the possibility of creating an infrastructure for small-scale LNG and start the transition from commercial segments of transport sector, primarily long-distance heavy trucks and machinery. CNG for taxi, LCV and individual cars segments can be obtained by LNG regasification.

The next step for authorities is to create a layout of CNG and LNG filling stations and objects of supporting infrastructure (cylinder inspection centers, service centers, retrofitting points etc). The layout should be based on the potential CNG and LNG demand research for the different segments of the transport sector (covering road, water, railway transport and off-road machinery):

a. Private cars
b. Taxi
c. Buses
d. LCVs
e. Trucks
f. Water transport
g. Railway transport
h. Quarry machinery
i. Construction, communal and agricultural machinery

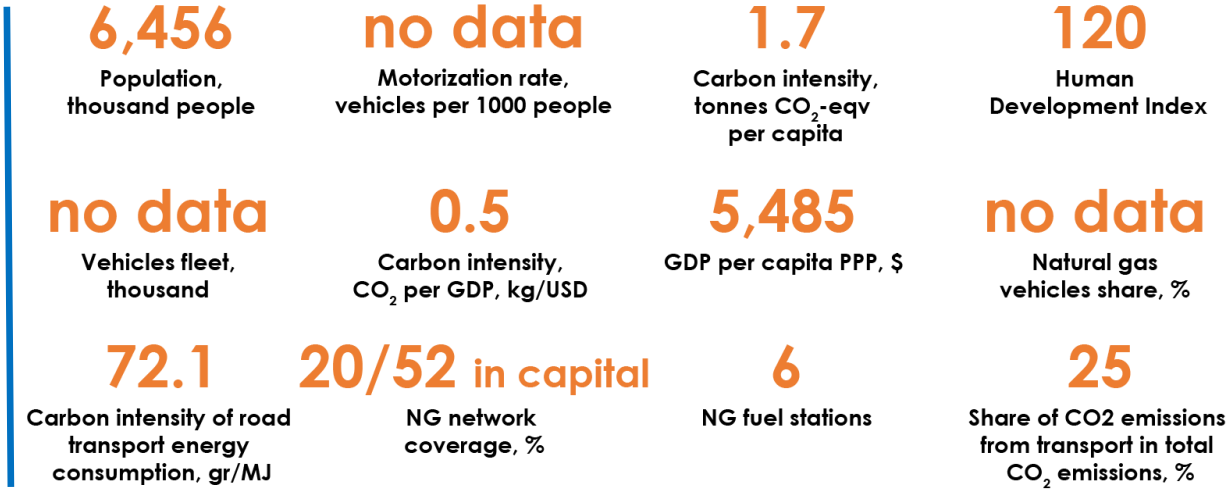
The number of the gas station infrastructure objects is to be calculated based on the results of the demand analyses. Whenever possible the gas station infrastructure objects should be located near highways and have access to gas networks. Then the need for supporting infrastructure should be estimated. The required investments and potential socio-economic and environmental effects of the NGV market can only be assessed after all potential locations for infrastructure facilities are determined. At the last stage, additional state support measures will be worked out.

Additional obligations to guarantee the environment protection in segments with high fuel consumption can make natural gas more attractive for final customers.

It should be mentioned that the construction of international Western Europe - China route provides great perspectives for LNG infrastructure development.

Kyrgyzstan

Factsheet



General information

Kyrgyzstan is located in a predominantly mountainous area. According to UN Human Development Index classification Kyrgyzstan ranks 120th and belongs to the group of countries with medium level of development. The GDP per capita at PPP is $ 5,485. Kyrgyzstan has a high unemployment rate.

Kyrgyzstan joined the UN Framework Convention on Climate Change in 2000. Kyrgyzstan ratified the Kyoto Protocol and the Paris Agreement in 2009 and 2016, respectively.

As part of its commitments under the Paris Agreement, Kyrgyzstan announced its intention to reduce greenhouse gas emissions by 13% by 1990 and subject to international financial support by 30%; and by 15% by 2050 and subject to international support by 36%.

The energy mix of Kyrgyzstan is dominated by oil (43%), hydropower (20%), coal (22%). Electricity is generated based on 90% hydropower and coal (10%). Kyrgyzstan is an importer of natural gas and other types of hydrocarbon resources. The gas network coverage in Bishkek is 52%, while in the rest of the region it is less than 20%, some regions of the country are not supplied with gas at all.

The transport sector in Kyrgyzstan accounts for 28% of GHG emissions, and in cities such as Bishkek, 75% of air pollutants. Most public transport vehicles are outdated. About 54% of the country's total public transport fleet (about 6,240 cars in 2017) are 15 years and older. Buses and vans are mostly diesel-fueled, while diesel engines generally only meet Euro-4 or lower standards. Road transport is an important contributor to air pollution in Kyrgyzstan.

Kyrgyzstan is still lagging behind the developed countries in introducing emission standards for both passenger cars and heavy-duty vehicles and buses. In 2014, the Eurasian Economic Commission increased the standards to Euro-5, they came into force in Kyrgyzstan in 2019, but only for fuel, not for vehicle engines. Vehicle

emission requirements and associated fuels are not necessarily aligned. In 1993-1997 the structure of transport sector changed dramatically: the number of trucks and buses dropped significantly, while the number of passenger cars increased.

Governmental regulation and market mechanisms

Some projects are being implemented in the country with the support of the international community.

In 2018, OECD and the Ministry of Economy of the Kyrgyz Republic stimulated the development of cleaner public transport on natural gas in major cities. Gazprom Kyrgyzstan launched 4 CNG stations by 2019.

The conversion of buses to natural gas increases the availability of transport services for the population and reduces the environmental burden on the urban environment.

In 2018, the National Council for Sustainable Development adopted a new National Development Strategy for 2018-2040. In the transport sector, the strategy envisions a shift to cleaner modes of transport using EVs and electrification of railways. As one of its goals, the Strategy for the Development of Road Transport for 2012-2015 was aimed to improve the technical condition of road transport based on other countries' experience. It also tried to restrict the operation of vehicles whose emissions exceeded the established standards.

Life cycle analysis

The figure 17 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).

The potential annual demand for natural gas in 20%-Scenario is 3,5

The potential annual demand for natural gas in 50%-Scenario is 4,5 bcm.

Figure 17. Transport transition scenarios, Kyrgyzstan

Source: NGVA Russia estimation

Guideline for Kyrgyzstan

Gas network coverage and fuel pricing conditions limit the perspectives for the NGV market development perspectives.

Taking into account the economic circumstances in the country and the environmental conditions in the capital, it is advisable to continue the implementation of the pilot project converting public transport to environmentally friendly fuels. High share of hydropower in the power mix makes BEV potentially quite effective for decarbonization. At the same time, old vehicles can be retrofitted to CNG without big investments in new vehicles.

In case of significant depreciation of fixed assets and transport vehicles, the priority for the market participants should be the repair and renewal of production equipment, as well as the renewal of the transport fleet.

Pilot initiatives for the development of small-scale LNG for mainline transport and autonomous power generation can be considered.

Moldova

Factsheet

3,550 Population, thousand people	**173** Motorization rate, vehicles per 1000 people	**2.3** Carbon intensity, tonnes CO_2-eqv per capita	**90** Human Development Index
677 Vehicles fleet, thousand	**0.3** Carbon intensity, CO_2 per GDP, kg/USD	**13,627** GDP per capita PPP, $	**0.7** Natural gas vehicles share, %
72.2 Carbon intensity of road transport energy consumption, gr/MJ	**20/90** NG network coverage, %	**27** NG fuel stations	**25** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

According to the UN Human Development Index classification, Moldova ranks 90th and belongs to the second group, the group with a high level of development. The GDP per capita at PPP is $ 13,627.

Moldova joined the UN Framework Convention on Climate Change in 1995 and consistently ratified the Kyoto Protocol and the Paris Agreement in 2003 and 2017. As part of its commitments under the Paris Agreement, Moldova announced its intention to reduce its CO_2 emissions by 79% by 2030 compared to 1990.

The energy mix of Moldova is formed by 55% natural gas, and the power mix – by 95%. Moldova is a net importer of natural gas. The supplier of natural gas is the Russian Federation. The gas network coverage reaches 90% in some areas, and in other areas, it is limited to 20%.
The share of transport emissions is 25% of total emission.

Most vehicles in Moldova are more than ten years old. Cars and buses run mostly on diesel, while diesel engines barely meet the Euro-4 standard. For example, out of 20,994 buses, 11,790 units (56% of the bus fleet) do not meet any European standard. Only about 7.7% of the total fleet complies with Euro-4-6 standards.

Governmental regulation and market mechanisms

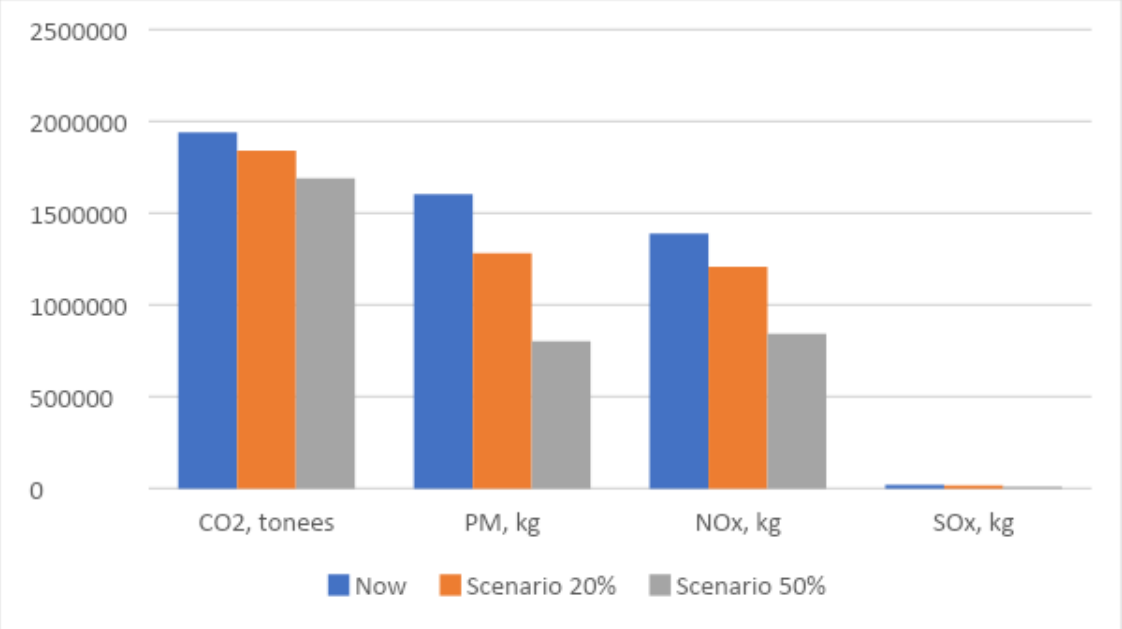
One of the objectives of the Program for the Promotion of the Green Economy of the Republic of Moldova for 2018-2020 states that «the integration into transport policies of environmental provisions that promote the use of alternative fuels and

new technologies for all types of transport». The Action Plan for its implementation includes targets for transport development: (1) Reducing air pollution by 30% by 2020 through the development of sustainable transport; (2) Modernization of the old public transport by replacing it with ecological (electric) transport; (3) Integration into transport policies of environmental provisions promoting the use of alternative fuels and new technologies for all modes of transport.
The program will focus on supporting the transition to modern buses running on environmentally friendly fuels such as LNG. In addition, wherever possible, it will help to strengthen the existing infrastructure for the use of trolleybuses.

Life cycle analysis

The figure 18 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is 1.5 bcm.
The potential annual demand for natural gas in 50%-Scenario is 1.8 bcm

Figure 18. Transport transition scenarios, Moldova



Source: NGVA Russia estimation

Guideline for Moldova

High share of natural gas in the power mix and developed gas distribution network provide an opportunity to develop both, BEV and NGV. The only missing element is a well-balanced sustainable scenario for economic, environmental and social objectives that has to be properly estimated.
The difference in fuel prices of CNG and gasoline (CNG is 55% cheaper) makes NGV quite attractive from an economic perspective. Retrofit of the existing old vehicles and switch to natural gas provides fast and cheap solution for environmental challenges.

In areas with low gas distribution network coverage it is advisable to consider the possibility of creating an infrastructure for small-scale LNG and start transition from the commercial segments of transport sector, primarily long-distance heavy trucks and machinery.

The next step for authorities is to create a layout of CNG and LNG filling stations and objects of supporting infrastructure (cylinder inspection centers, service centers, retrofitting points etc). The layout should be based on the potential CNG and LNG demand research for the different segments of the transport sector (covering road, water, railway transport and off-road machinery):

a. Private cars
b. Taxi
c. Buses
d. LCVs
e. Trucks
f. Water transport
g. Railway transport
h. Quarry machinery
i. Construction, communal and agricultural machinery

The number of the gas station infrastructure objects is to be calculated based on the results of the demand analyses. Whenever possible the gas station infrastructure objects should be located near highways and have access to gas networks. Then the need for supporting infrastructure should be estimated.

The required investments and potential socio-economic and environmental effects of the NGV market can only be assessed after all potential locations for infrastructure facilities are determined. At the last stage, additional state support measures will be worked out.

Additional obligations to guarantee the environment protection in segments with high fuel consumption can make natural gas more attractive for final customers.

North Macedonia

Factsheet

2,983 Population, thousand people	**194** Motorization rate, vehicles per 1000 people	**3.3** Carbon intensity, tonnes CO_2-eqv per capita	**82** Human Development Index
415 Vehicles fleet, thousand	**0.2** Carbon intensity, CO_2 per GDP, kg/USD	**17,607** GDP per capita PPP, $	**no data** Natural gas vehicles share, %
72.4 Carbon intensity of road transport energy consumption, gr/MJ	**limited** NG network coverage, %	**8** NG fuel stations	**22** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

According to the UN Human Development Index classification, Macedonia ranks 82nd and belongs to the second group, the group with a high level of development. GDP per capita at PPP is $ 17,607. North Macedonia is a candidate for EU membership.

North Macedonia joined the UN Framework Convention on Climate Change in 1998, than signed the Kyoto Protocol and the Paris Agreement in succession. As part of its commitments under the Paris Agreement, North Macedonia announced its intentions to further develop the principles of a green economy based on the country's desire to help reducing emissions.

The energy mix of Moldova is 35% coal and 40% oil, the share of gas is less than 7%. In electricity generation, the share of gas is 11%, and 60% is generated from coal-fired power plants. North Macedonia is a net importer of all types of energy resources, including natural gas. Its share has been growing steadily since 1998.

The gas network coverage is insignificant. The main gas consumption relates to the industry.
There are 8 CNG filing stations in the country. The price of CNG is 47.5% lower than gasoline price.

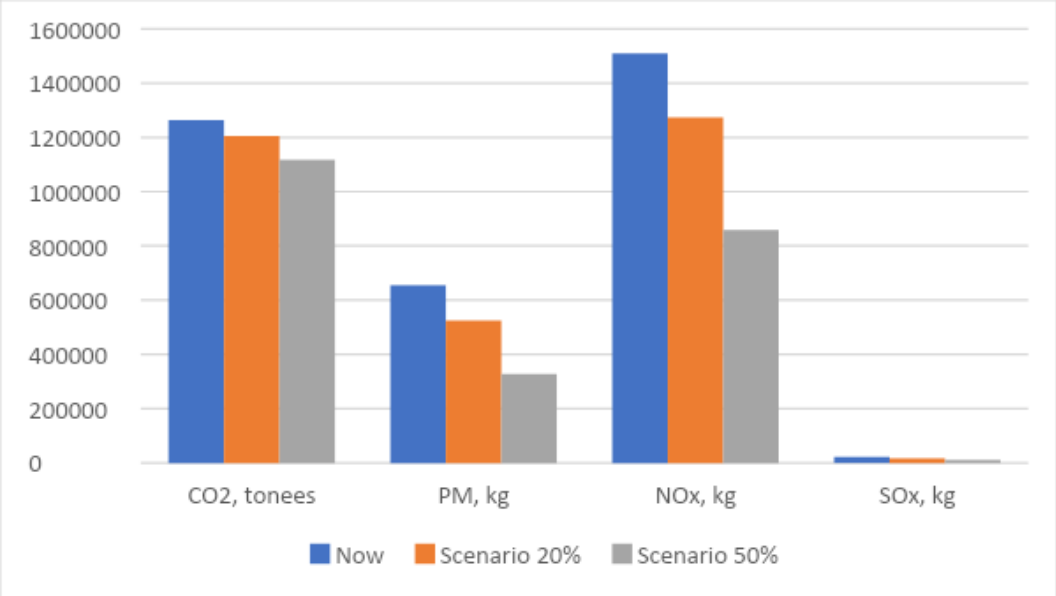
Governmental regulation and market mechanisms

There is no information about any governmental initiatives stimulating the NGV market.

Life cycle analysis

The figure 19 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is 1.0 bcm.
The potential annual demand for natural gas in 50%-Scenario is 1.2 bcm.

Figure 19. Transport transition scenarios, North Macedonia



Source: NGVA Russia estimation

Guideline for North Macedonia

The power mix of the country is mostly based on coal. Without significant investments in power sector, BEV implementation will only worsen indicators of greenhouse gas emissions. Full lifecycle analysis of BEV's perspectives is possible in case of modeling long-term energy sector structure development.
Taking into account the high level of carbon intensity and the difference between the prices of natural gas and petroleum fuel, there are fundamental request for the NGV market development.
The main barrier to the NGV market development is low coverage of gas distribution network. In these conditions, it is advisable to consider the possibility of creating an infrastructure for small-scale LNG and start transition from the commercial segments of transport sector, primarily long-distance heavy trucks and machinery. CNG for taxi, LCV and individual cars segments can be obtained by LNG regasification.
It is recommended to consider the possibility of a pilot project in the field of small-scale LNG for trucks, mainline bus transport and quarry machinery.

Romania

Factsheet

19,356 Population, thousand people	**330** Motorization rate, vehicles per 1000 people	**3.7** Carbon intensity, tonnes CO_2-eqv per capita	**49** Human Development Index
6,452 Vehicles fleet, thousand	**0.1** Carbon intensity, CO_2 per GDP, kg/USD	**32,297** GDP per capita PPP, $	**-** Natural gas vehicles share, %
69.2 Carbon intensity of road transport energy consumption, gr/MJ	**Limited, but developed in some areas** NG network coverage, %	**26** NG fuel stations	**22.4** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Romania is located on the Black Sea coast. According to the UN Human Development Index classification, Romania ranks 49th and belongs to the first group with a very high level of development. GDP per capita at PPP is $32,397.

Romania joined the UN Framework Convention on Climate Change in 1994. Romania ratified the Kyoto Protocol and the Paris Agreement in 2001 and 2017, respectively. As part of its commitments under the Paris Agreement, Romania announced a 32% increase in energy efficiency and a 32% increase in renewable energy sources in the fuel and energy sector.

Romania's energy mix is equally shaped by natural gas, nuclear energy, and oil. The power mix contains of nuclear, gas, coal, hydro, and about 10% is renewables.
Romania is a net importer of natural gas. Domestic production covers about 85% of the country's needs and is declining.
Some areas of the country are well covered by gas distribution networks, while others have not natural gas at all. Presumably, the average gas network coverage is no more than 15%.
Now there are 26 CNG filling stations. But CNG is 60% more expensive than LPG.

Governmental regulation and market mechanisms

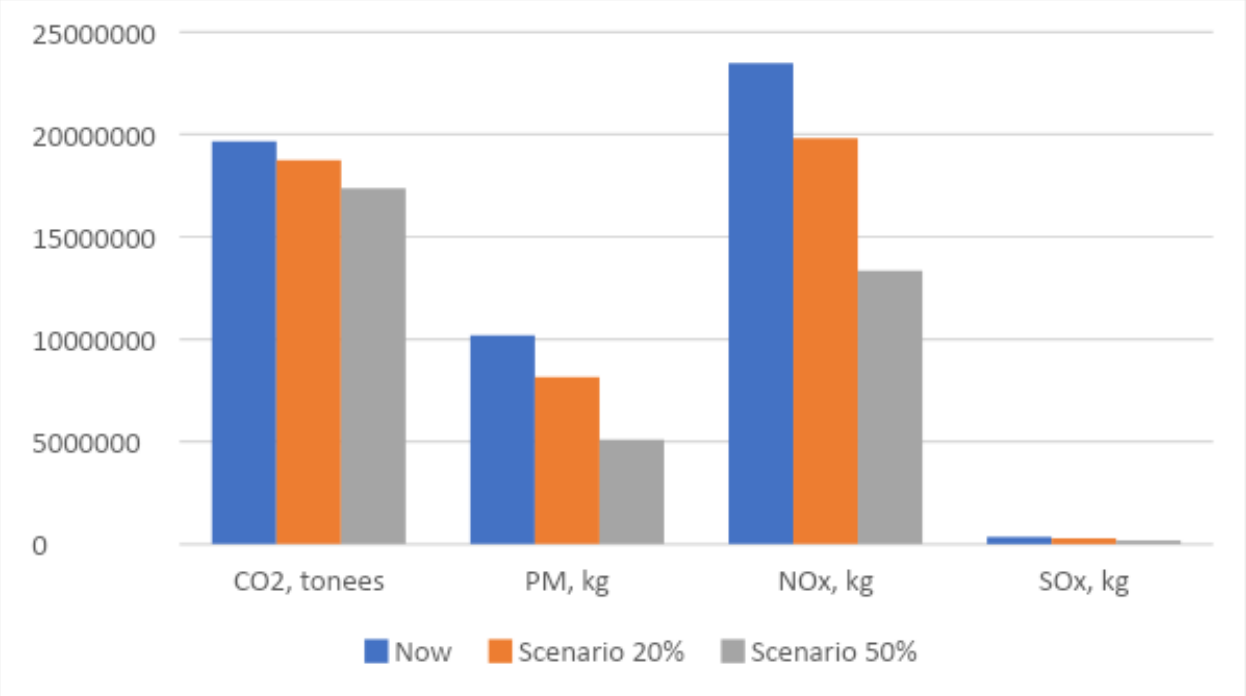
According to the Directive 2014/94 on the development of alternative fuel infrastructure, EU member States are required to adopt and define national targets for the deployment of EV and CNG infrastructure in urban and suburban areas and on the TEN-T core network.
It is planned to construct small scale LNG for river and marine bunkering.

In 2015, with the support of the European Union, the project "CNG ROMANIA: Implementation of the first network of gas stations for compressed natural gas vehicles in Romania along the European transport corridors"[1] was launched. The project partner was NGVA Romania, the Association of natural gas for vehicles. The project aimed to provide a network of 9 CNG filling stations on the Romanian sections of the Rhine-Danube and East-Eastern Mediterranean corridors up to 2022, including important network hubs to simultaneously meet the potential demand for transit and urban transport. Support for market penetration and implementation of CNG in Romania is supposed to construct the network of CNG filling stations for cars that will be located near the main city hubs of Bucharest and Timisoara, as well as other important cities located on the Central transport network, respectively: Arad, Constanta, Craiova, Virgo, Drobeta Turnu-Severin, Pitesti and Sibiu. The € 5.2 million project benefits from 85% EU co-financing and aims to decarbonize and increase mobility in Europe by hosting the first CNG network in Romania.

Life cycle analysis

The figure 20 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is15.5 bcm.
The potential annual demand for natural gas in 50%-Scenario is 19.4 bcm.

Figure 20. Transport transition scenarios, Romania



Source: NGVA Russia estimation

Guideline for Romania

There are some barriers for the further development of the NGV market: low distribution network coverage and low prices for LPG (natural gas is 60% more expensive).
Nevertheless, natural gas remains the most affordable alternative to improve the environmental situation, especially in in segments with high fuel consumption (e.g. river transport).
The next step is to create a layout of CNG and LNG filling stations and objects of supporting infrastructure (cylinder inspection centers, service centers, retrofitting points etc). The layout should be based on the potential CNG and LNG demand research for the different segments of the transport sector (covering road, water, railway transport and off-road machinery):

a. Private cars
b. Taxi
c. Buses
d. LCVs
e. Trucks
f. Water transport
g. Railway transport
h. Quarry machinery
i. Construction, communal and agricultural machinery

The number of the gas station infrastructure objects is to be calculated based on the results of the demand analyses. Whenever possible the gas station infrastructure objects should be located near highways and have access to gas networks. Then the need for supporting infrastructure should be estimated.
The required investments and potential socio-economic and environmental effects of the NGV market can only be assessed after all potential locations for infrastructure facilities are determined. At the last stage, additional state support measures will be worked out
Additional obligations to guarantee the environment protection in segments with high fuel consumption can make natural gas more attractive for final customers.

Serbia

Factsheet

6,944 Population, thousand people	**252** Motorization rate, vehicles per 1000 people	**6.4** Carbon intensity, tonnes CO_2-eqv per capita	**64** Human Development Index
1,715 Vehicles fleet, thousand	**0.4** Carbon intensity, CO_2 per GDP, kg/USD	**19,013** GDP per capita PPP, $	**no data** Natural gas vehicles share, %
72.6 Carbon intensity of road transport energy consumption, gr/MJ	**limited** NG network coverage, %	**3** NG fuel stations	**16** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Serbia is located mainly in mountainous areas, without access to the sea. According to the UN Human Development Index classification, Serbia is ranked 64th and belongs to the first group, a group with a very high level of development. GDP per capita at PPP is $19,013. Serbia is a candidate for the European Union.

Serbia joined the UN Framework Convention on Climate Change in 2001 and ratified the Kyoto Protocol and the Paris Agreement successively in 2007 and 2016. As part of its commitments under the Paris Agreement, Serbia has announced plans to reduce its emissions by 10% by 2030 compared to 1990, reduce emissions in the transport sector by 10% by 2030 and by 30-54% by 2050. The share of transport in the overall emission is 15%.

Serbia's energy mix is formed by 50% coal and 13% natural gas. The power mix consists of 70% coal and 30% hydro. Serbia is a net importer of all types of energy resources, including natural gas. Natural gas is supplied by the Russian Federation. Gas is mainly used in the industry. The gas network coverage is insignificant.

Governmental regulation and market mechanisms

The EU's assistance to the energy sector is aimed at improving the energy efficiency and competitiveness of the Serbian energy market, improving the security of supply, including in the regional context, and developing renewable energy sources. The following outcome targets are mentioned:

- Improve the security of power, transmission, and gas transportation, facilitating the integration of the regional market.

- Priority investments from the Single national gas pipeline project will be supported, especially in such areas as gas transportation. Support will be provided for further harmonization of Serbian energy legislation in line with the Energy Community Treaty and commitments.

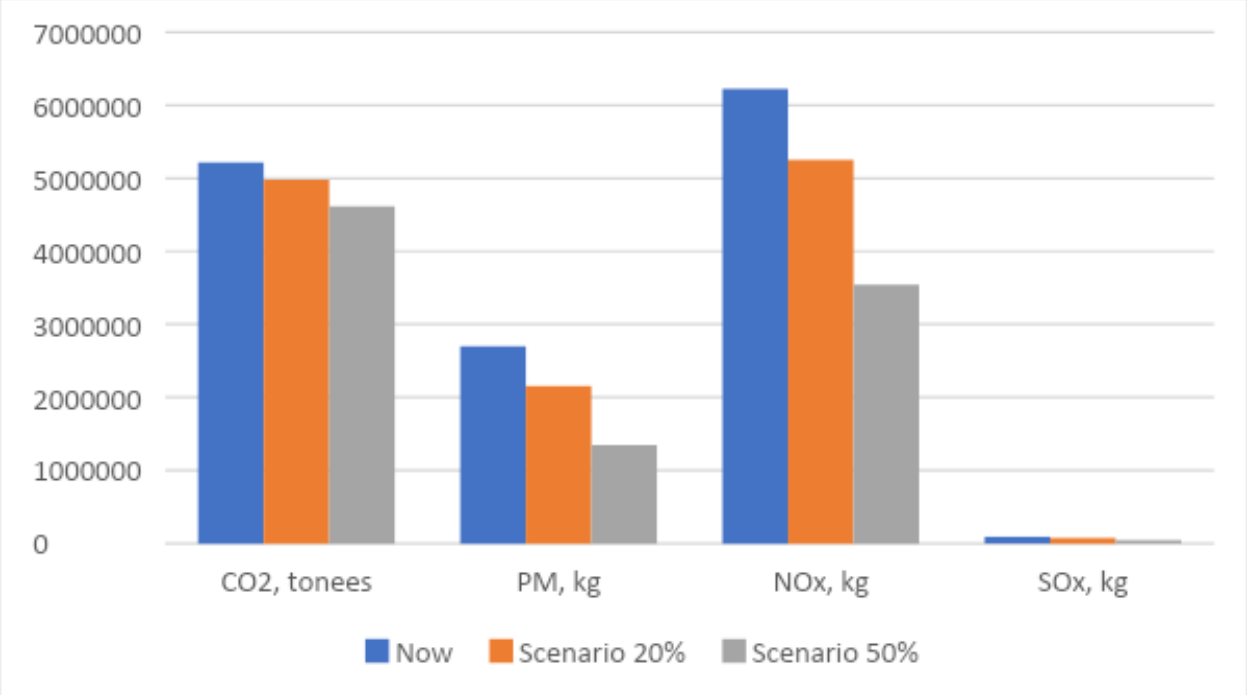
In 2015, Gazprom and 'Srbijagas' signed a Memorandum of understanding. The document reflects the parties' intention to consider the possibility of developing cooperation in the field of underground gas storage, NGV, and small-scale LNG.

The EBRD is financing the modernization of public transport in Novi Sad, Serbia, as part of the first project under the EBRD's Green cities program, aimed at addressing environmental challenges in the city. A loan agreement of 7 million euro signed by the EBRD and the Novi Sad Public transport company has allowed the company to purchase 7 new buses.

Life cycle analysis

The figure 21 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is 4.1 bcm.
The potential annual demand for natural gas in 50%-Scenario is 5.1 bcm.

Figure 21. Transport transition scenarios, Serbia



Source: NGVA Russia estimation

Guideline for Serbia

The power mix of the country is mostly based on coal. Without significant investments in power sector, BEV implementation will only worsen indicators of

greenhouse gas emissions. Full lifecycle analysis of BEV's perspectives is possible in case of modeling long-term energy sector structure development.

Taking into account the high level of carbon intensity and the difference between the prices of natural gas and petroleum fuel, there are fundamental request for the NGV market development.

The main barrier to the NGV market development is low coverage of gas distribution network. In these conditions, it is advisable to consider the possibility of creating an infrastructure for small-scale LNG and start transition from the commercial segments of transport sector, primarily long-distance heavy trucks and machinery. CNG for taxi, LCV and individual cars segments can be obtained by LNG regasification.

It is recommended to consider the possibility of a pilot project in the field of small-scale LNG for trucks, mainline bus transport and quarry machinery.

Tajikistan

Factsheet

9,321 Population, thousand people	**38** Motorization rate, vehicles per 1000 people	**0.8** Carbon intensity, tonnes CO_2-eqv per capita	**125** Human Development Index
300 Vehicles fleet, thousand	**0.2** Carbon intensity, CO_2 per GDP, kg/USD	**3,529** GDP per capita PPP, $	**no data** Natural gas vehicles share, %
72 Carbon intensity of road transport energy consumption, gr/MJ	**limited** NG network coverage, %	**53** NG fuel stations	**17** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Tajikistan is located mainly in mountainous areas (93%). According to the UN Human Development Index classification, Tajikistan ranks 125th and belongs to the third group, the group with a medium level of development. The GDP per capita at PPP is $3,529.

Tajikistan joined the UN Framework Convention on Climate Change in 1998 and ratified The Kyoto Protocol and the Paris Agreement in 2008 and 2017, respectively. As part of its commitments under the Paris Agreement Tajikistan has announced its intentions to reach the level of 80-90% of 1990 emissions by itself, and the level of 65-75% with international support.
Tajikistan's energy mix is formed by 40% hydroelectric power, 30% coal, 23% oil. Electricity generation is formed by 95% of hydro resources. Tajikistan is an importer of hydrocarbon resources.

There are 54 CNG filling stations and more than 10 thousand of NGVs in the country.
Since 2012 there have been simultaneous interruptions in gas supplies from Kazakhstan and Uzbekistan. During the period of supply restrictions, Tajikistan produced gas from coal. In 2018, an agreement was reached on the resumption of Uzbek gas supplies to Tajikistan, however, because of the tension in international relations interruptions in gas supplies still occur.
Gas transport infrastructure was damaged during the suspension period.

Governmental regulation and market mechanisms

Most of the passenger and freight transport is carried out by road. However, the efficiency of Tajikistan logistics is considered to be one of the lowest in the world. The development of transit highways is planned in the country.
In the State Target Program for the Development of the Transport Complex of the Republic of Tajikistan until 2025, one of the goals is to «convert part of motor transport to environmentally friendly types of motor fuel, primarily natural gas».
At the same time, the country is currently deprived of reliable sources of natural gas. Electrification of transport is only partially possible, as hydro-supply is seasonal.

Life cycle analysis

The figure 22 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is 0.7 bcm.
The potential annual demand for natural gas in 50%-Scenario is 0.9 bcm.

Figure 22. Transport transition scenarios, Tajikistan

Source: NGVA Russia estimation

Guideline for Tajikistan

Gas network coverage and gas supply restrictions constrain the NGV market development.
Taking into account the economic situation in the country and the environmental conditions in the capital, it is advisable to continue the pilot project aimed at converting public transport to environmentally friendly fuels. Hydro-supply is

seasonal, so it is difficult to develop sustainable e-mobility concept. At the same time, public transport and personal cars can be easily retrofitted to CNG without large investments in the new vehicles.
Pilot initiatives for the development of small-scale LNG for mainline transport and autonomous power generation can be considered.

Turkmenistan

Factsheet

5,942 Population, thousand people	**145** Motorization rate, vehicles per 1000 people	**11.8** Carbon intensity, tonnes CO_2-eqv per capita	**111** Human Development Index
865 Vehicles fleet, thousand	**0.7** Carbon intensity, CO_2 per GDP, kg/USD	**15,207** GDP per capita PPP, $	**0** Natural gas vehicles share, %
71.2 Carbon intensity of road transport energy consumption, gr/MJ	**99** NG network coverage, %	**0** NG fuel stations	**6** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Turkmenistan is located mainly in mountainous areas on the Caspian Sea shore. According to the UN Human Development Index classification, Turkmenistan ranks 111th and belongs to the second group, the group with a high level of development. The GDP per capita at PPP is $ 15,207.

Turkmenistan joined the UN Framework Convention on Climate Change in 1995, and also ratified the Kyoto Protocol and the Paris Agreement in 1999 and 2016. As part of its commitments under the Paris Agreement, Turkmenistan has announced zero growth in emissions by 2030.

The energy mix of Turkmenistan is formed by 78% of natural gas, 12% by oil. Turkmenistan is a natural gas exporter, the 4th world largest country in terms of natural gas reserves.
The natural gas distribution network coverage reaches 99%. However, NGV market does not exist. The country has implemented a unique GTL project, the largest in the region.

Governmental regulation and market mechanisms

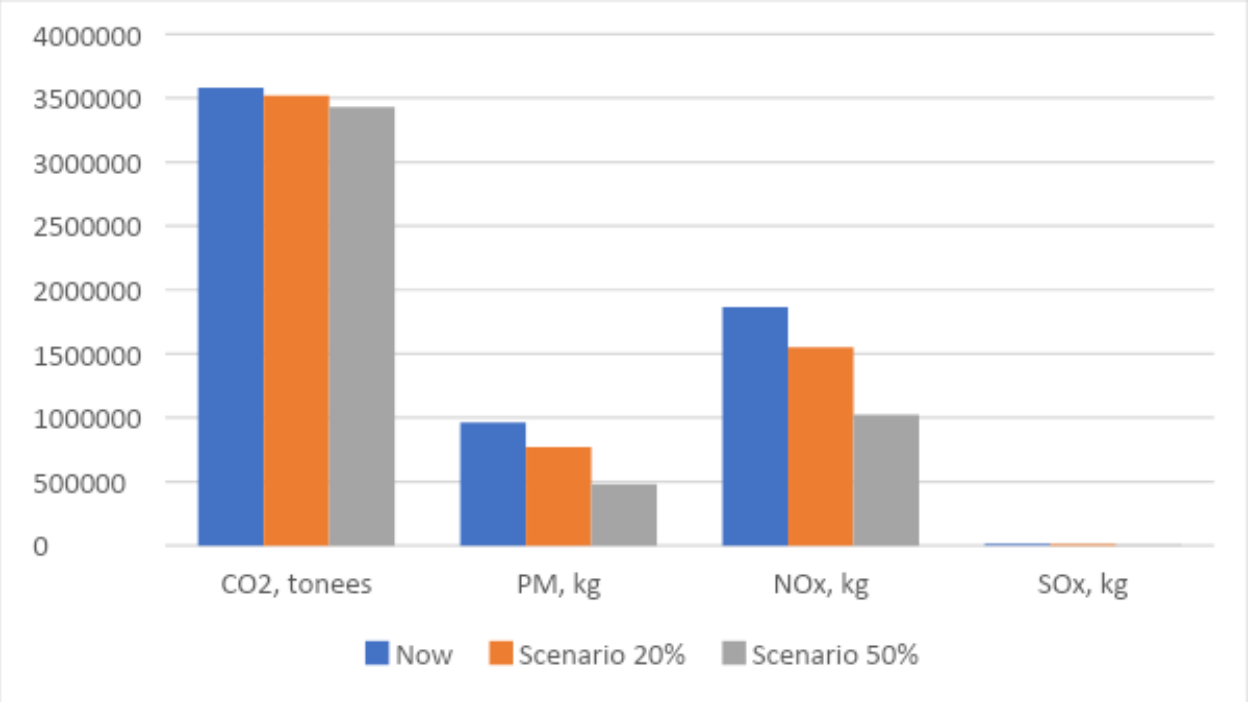
Turkmenistan does not have a car fuel market as such. Every resident of the country gets a free ticket for refueling cars with gasoline every year. There is no CNG filling station infrastructure.
Turkmenistan adopted the National climate change strategy in 2012. After the Paris Agreement was signed and some climate commitments were adopted, the media reported on the development of programs for converting transport to NGV.
State Concern 'Turkmengaz' has completed a feasibility study of the project in 2018; at the first stage it provides for the transfer of 12 thousand vehicles that are on the

balance sheet of the oil and gas complex to liquefied gas. This will reduce the diesel fuel consumed in the country by 14 per cent. Within the framework of the project six existing stationary natural gas filling stations are to be reconstructed and eight new stationary natural gas filling stations are to be built; in addition to that four mobile gas filling stations will be purchased.
Taking into account the centralized decision-making model and the development of the consumer sector, the transfer of the car fleet can be carried out in a fairly short time[11].

Life cycle analysis

The figure 23 contains 2 scenarios of transition to NGV (up to 20% and 50% of the vehicle fleet).
The potential annual demand for natural gas in 20%-Scenario is 3.0 bcm.
The potential annual demand for natural gas in 50%-Scenario is 3.2 bcm.

Figure 23. Transport transition scenarios, Turkmenistan



Source: NGVA Russia estimation

Guideline for Turkmenistan

Turkmenistan is a sparsely populated country, with significant natural gas reserves and a high level of gas network coverage. There are all basic prerequisites for transport transition to natural gas in the country. At the same time, the transfer of transport will require complex program of market development.
The next step is to create a layout of CNG and LNG filling stations and objects of supporting infrastructure (cylinder inspection centers, service centers, retrofitting

points etc). The layout should be based on the potential CNG and LNG demand research for different segments of the transport sector (covering road, water, railway transport and off-road machinery):

a. Private cars
b. Taxi
c. Buses
d. LCVs
e. Trucks
f. Water transport
g. Railway transport
h. Quarry machinery
i. Construction, communal and agricultural machinery

The number of the gas station infrastructure objects is to be calculated based on the results of the demand analyses. Whenever possible the gas station infrastructure objects should be located near highways and have access to gas networks. Then the need for supporting infrastructure should be estimated.

The required investments and potential socio-economic and environmental effects of the NGV market can only be assessed after all potential locations for infrastructure facilities are determined. At the last stage, additional state support measures will be worked out.

Small-scale LNG projects are also seen as an additional way to export gas to the neighbor countries.

Uzbekistan

Factsheet

33,580 Population, thousand people	**70** Motorization rate, vehicles per 1000 people	**3.3** Carbon intensity, tonnes CO_2-eqv per capita	**106** Human Development Index
2,272 Vehicles fleet, thousand	**0.4** Carbon intensity, CO_2 per GDP, kg/USD	**7,308** GDP per capita PPP, $	**48** Natural gas vehicles share, %
63.4 Carbon intensity of road transport energy consumption, gr/MJ	**85** NG network coverage, %	**1070** NG fuel stations	**13** Share of CO2 emissions from transport in total CO_2 emissions, %

General information

Uzbekistan is located mainly in mountainous areas. According to the UN Human Development Index classification, Uzbekistan ranks 106th and belongs to the third group, the group with high level of development. The GDP per capita at PPP is $ 7,308.
Uzbekistan has a well-developed automobile industry, including the production of gas-powered vehicles and gas-cylinder equipment.
The state presence in the main sectors of the economy is quite high: the country pursues the policy of protectionism.
Uzbekistan is one of the most energy- and carbon-intensive countries in the world due to outdated energy and grid equipment.

Uzbekistan joined the UN Framework Convention on Climate Change in 1993 and has consistently ratified the Kyoto Protocol and the Paris Agreement in 1999 and 2017. As part of its commitments under the Paris Agreement, Uzbekistan is committed to reducing GDP emissions by 10% by 2030 compared to 2010.

The strategy of structural reforms outlines the transition to a resource-efficient model of economic growth. The Strategy of five directions states "expansion of production and use of motor fuel and vehicles with improved energy efficiency and environmental friendliness, as well as the development of electric transport".

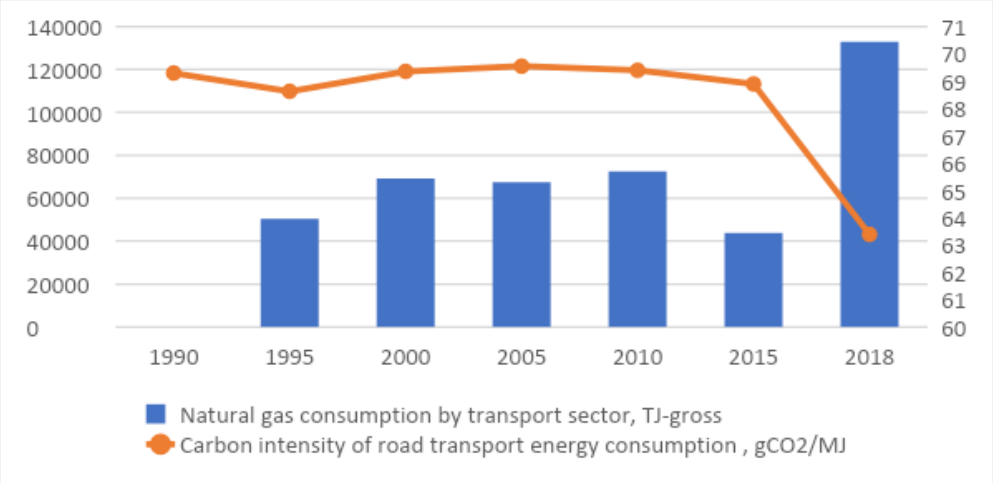
The energy mix of Uzbekistan is formed 85% by natural gas, 8% by oil. The power mix is 88% dependent on natural gas and 10% on hydropower. Uzbekistan is a net exporter of hydrocarbon resources and natural gas. The gas network coverage reached 77-85 % by 2021.

Despite significant volumes of gas reserves, production is falling, which requires significant investment in exploration and infrastructure development. The country has introduced a gas-saving regime in some sectors of the economy, which periodically leads to power and gas supply shutdowns[4].

Governmental regulation and market mechanisms

The government of Uzbekistan has adopted a program for the gradual conversion of road transport to gas-powered fuel during 2007-2012.
Following the Concept of environmental protection until 2030, at least 50% of public transport in Uzbekistan is to switch to alternative fuels to reduce its emissions of harmful substances.
This measure is extremely relevant to the cities of Uzbekistan. According to the World Air Quality Index Tashkent ranks second in terms of air pollution among the world's cities in the online air monitoring index in 2019.
The state program has stimulated a liberal model of market development, most CNG filling stations are owned by private entrepreneurs. Preferential loans and fiscal incentives were aimed to foster the market. A simplified procedure for allocating land plots and preferential connection to the gas pipeline is foreseen for the entrepreneurs as a form of state support, while there is no direct subsidy to the owners of CNG filling stations or consumers.
On December 1, 2017 restrictions on the allocation of land plots for the construction of new gas filling stations were introduced. Meanwhile, the existing filling stations are to be gradually converted to CNG filling stations.
As of 2021, about 700 CNG stations are operating in the country. 48% of the fleet, or just over 1.1 million vehicles, have been converted to CNG. The volume of natural gas consumption as a motor fuel is 2.7 billion cubic meters.
The figure 24 shows that carbon intensity has significantly decreased with the increase in consumption of natural gas as a natural fuel.

Figure 24. Gas consumption and carbon intensity of transport sector in Uzbekistan



Source: International Energy Agency

Natural gas proved to be more competitive than LPG in terms of economic and environmental parameters. In October 2018, the government decided to ban the use of propane-butane as motor fuel in the coming years.
The country has introduced a simplified regime for the purchase and installation of gas cylinder equipment on motor vehicles by providing preferential loans and on-site bank services for processing credit agreements in the proximity of CNG filling stations on a “one-stop-shop” basis.
To monitor the technical condition of gas cylinder equipment on motor vehicles in real-time Uzbekneftegaz is establishing a single dispatch center is to manage the implementation and operation of the specialized information system. This system will be in charge of monitoring the technical conditions and operation of CNG filling stations, as well as of compressed natural gas consumption records[10].
Uzbekistan has a great potential for gasification of transport, improving energy efficiency and saving energy costs.
There are about 40,000 units of agricultural machinery operating in the country. The conversion of equipment to natural gas will simultaneously improve the environmental and economic performance of the sector in the long term.
Pilot models for the use of natural gas in agriculture in Uzbekistan were launched in 2018-2020.
The country successfully cooperates with foreign car manufacturers MAN and producers of methane tractors New Holland.
Better emission indicators in Uzbekistan demonstrates that gasification of the country's automobile fleet not only reduces the environmental burden and climate risks, but also promotes the economic growth due to higher mobility. Bearing in mind that the country’s GDP is below the average, the general trend on low carbon sustainable mobility becomes quite advantageous.

Guideline for Uzbekistan

Uzbekistan progressed in transport sector transition to natural gas. Favorable factors include a Comprehensive state policy on shifting transport to natural gas, a liberal market development model that allows market participants to become successful entrepreneurs in the emerging market of natural gas fuel have contribute to the success.
The free-market model, however, badly needs a framework for CNG filling stations’ safety and CNG cylinders turnover regulations.
Considering the fact that the level of motorization in Uzbekistan is only 70 units per 1000 inhabitants, there is a sufficient room for the country's growing vehicle fleet. Active promotion of natural gas as a motor fuel will allow the consumers to make a rational choice.

Comparative Analysis of Safety Requirements for Refueling Stations

UNECE countries abide by two different systems of technical regulation. Former Soviet Union countries stick to the Soviet system of technical regulation, while other countries use International standards.

Table 4. Technical regulations in UNECE countries

Country	Technical regulations
Armenia	– IMAS 21-01-2014 Fire safety of buildings and structures – GOST 28338-89 (ISO 6708-80) Pipeline connections and fittings. Nominal diameters. Rows – MCH 3.02.01-2002 Production buildings
Azerbaijan	No information about government regulation
Belarus	– TKP 612-2017 (33240) Technical code of practice: design, construction and operation of CNG filling stations – TKP 474-2013 Categorization of premises, buildings and outdoor installations by explosion and fire hazards – TKP 45-2. 02-34-2006 Buildings and structures. Fire departments. Design standards. – NSS 4.02.01-03 Heating, ventilation and air conditioning – TKP 45-2. 02-315-2018 Fire safety of buildings and structures. Building design standards – TKP 336-2011 Lighting protection of buildings, structures and engineering communications – SANPIN 35-2014 Requirements for the organization of sanitary protection zones of enterprises, structures and other objects – TKP 253-2010 Gas filling stations
Bosnia and Herzegovina	– ISO 16923:2016 covers the design, construction, operation, inspection and maintenance of stations for fuelling compressed natural gas (CNG) to vehicles, including equipment, safety and control devices. – ISO 16924:2016 Natural gas fuelling stations — LNG stations for fuelling vehicles
Bulgaria	– ISO 16923:2016 covers the design, construction, operation, inspection and maintenance of stations for fuelling compressed natural gas (CNG) to vehicles, including equipment, safety and control devices. – ISO 16924:2016 Natural gas fuelling stations — LNG stations for fuelling vehicles
Kazakhstan	– Technical regulations "Safety requirements for gas filling stations and gas-consuming installations" approved by the resolution of the Government of the Republic of Kazakhstan dated March 3, 2009 No. 248 – Design standards for vehicle gas-filling compressor stations introduced 2011-04-01 – TR RK 439-2017 General requirements for fire safety – SNiP of the Republic of Kazakhstan 2.02-01-2001 fire Department safety of buildings and structures. Building codes and regulations – SN RK 4.03-01-2010 Standards design of automobile gas-filling compressor stations

Country	Technical regulations
	– TR RK 1111-2016 Requirements for the equipment of buildings, premises and structures with automatic fire extinguishing systems and automatic fire alarm systems, warning and management of evacuation of people in case of fire – SP RK 2.04-103-2013 Lightning protection device for buildings and structures – SP RK 93-2012 Sanitary and epidemiological requirements for industrial buildings and structures – SN RK 4.03-01-2010 Design standards for automobile gas-filling compressor stations
Kyrgyzstan	– Building codes of the Kyrgyz Republic 21-02:2018: Petrol stations. Fire regulations – Building codes of the Kyrgyz Republic. Gas stations. Fire safety regulations – Sanitary and epidemiological rules and regulations 201-2016 "Sanitary protection zones and sanitary infrastructure classification of enterprises, structures, and other objects".
Moldova	– ONTP 24-86 Definition of the category of premises and buildings by explosion and fire hazard – GOST 30247.0-94 (ISO 834-75) Construction Structures. Methods of fire resistance testing. General requirements – NCM E.03. 02-2001 Fire Department safety. Fire protection of buildings and structures – SANPIN of the Ministry of health and social Protection of the PMR 2.2.1/2.1.1.1200-07 Sanitary and epidemiological rules and regulations
North Macedonia	– ISO 16923:2016 covers the design, construction, operation, inspection and maintenance of stations for fuelling compressed natural gas (CNG) to vehicles, including equipment, safety and control devices. – ISO 16924:2016 Natural gas fuelling stations — LNG stations for fuelling vehicles
Romania	– ISO 16923:2016 covers the design, construction, operation, inspection and maintenance of stations for fuelling compressed natural gas (CNG) to vehicles, including equipment, safety and control devices. – ISO 16924:2016 Natural gas fuelling stations — LNG stations for fuelling vehicles
Serbia	– ISO 16923:2016 covers the design, construction, operation, inspection and maintenance of stations for fuelling compressed natural gas (CNG) to vehicles, including equipment, safety and control devices. – ISO 16924:2016 Natural gas fuelling stations — LNG stations for fuelling vehicles
Tajikistan	– Technical regulation "Safety of natural gas prepared for transportation and use" approved by the Decree of the Government of the Republic of Tajikistan dated May 31, 2019, No. 274 – - SN and P 2.04.09-84 Fire automation buildings and structures
Turkmenistan	– RD 34.21.122-87 instructions for lightning protection of buildings and structures" and standards of the International Electrotechnical Commission (IEC).
Uzbekistan	– Resolution of Cabinet of Ministers of the Republic of Uzbekistan dated October 11, 2017 No. 815on Additional measures for the development of

Country	Technical regulations
	a network of gas-filling compressor stations and the gradual conversion of vehicles to compressed natural gas, as well as to ensure the safe operation of gas-cylinder equipment on them. – TR of Uzbekistan dated February 28, 2018 No. MTR-9 Special technical regulations on the safe operation of compact (modular) and mobile gas-filling compressor stations – IKN 14: 2009 Design of grounding and lightning protection devices for telecommunications facilities – SNK 2.01.19-09 Fire automation buildings and structures – SNK 2.01.02-04 Fire safety of buildings and structures – SANPIN No. 0350-17 Sanitary norms and rules for the protection of atmospheric air in populated areas of the Republic Uzbekistan

Soviet experience based technical regulations sets the requirements for the following aspects:

- Fire safety requirements
  - Fire resistance
  - Alarm systems
  - Lightning protection and grounding
  - Requirements for the placement and territory
  - Fire risk coefficient that determines the distance to objects
- Industrial safety requirements
  - Safety requirements for design and equipment;
  - Operational safety requirements;
  - Safety requirements for tank, group cylinder installations, etc.

International Standards (ISO) covers the following aspects:

- Fire protection,
- Explosion protection measures,
- Site layout,
- Environmental requirements,
- Operational safety requirements and requirements to equipment,
- Control system and emergency shutdown.

The most significant for investors is the requirement for minimum distances from refueling facilities to other facilities. These requirements determine the size of land plot and the cost of construction. The table below allows to compare the such requirements in UNECE countries.

Table 5. Required distances from CNG and LNG stations to other facilities

Country	Name of buildings, structures and outdoor units of motor carrier	Distance from LNG stations (in meters)	Distance from CNG stations (in meters)	Source of requirements
Armenia	Crowded places	60		Applied by analogy with Russian P 156.13130.2014
	Public road network	25		
	From LNG underground tanks	20		
	Distance between the axes of gas-filling stations	no less than 10.5		MSPMD 21-01-2014 Fire safety of buildings and structures
	Passage width from driveway (should be separated from lawn by means of border stone)	no less than 4		
Azerbaijan	Places with possible flame formation from crowded places	50	50	Fire safety rules of the Republic of Azerbaijan
	From other buildings if fire safety walls are available	15	15	
Belarus	Production buildings and premises of A, B, G1 & G2 categories Outdoor units of AN, BN, VN, GN categories; storage areas for vehicles designed for dangerous goods of 2–4, 8 classes and 9.1 underclass, as per GOST 19433	40	30	TKP 253-2010 (02300), GAS-FILLING STATIONS. FIRE SAFETY. DESIGN NORMS & RULES FOR CONSTRUCTION, Ministry for Emergency Situations

Country	Name of buildings, structures and outdoor units of motor carrier	Distance from LNG stations (in meters)	Distance from CNG stations (in meters)	Source of requirements
	Production buildings of V1–V4 & D categories, premises of V1–V4 & D categories, outdoor units: buildings of I, II, III, IV fire ratings and outdoor units of DN category, buildings of V, VI fire ratings, buildings of VII, VIII fire ratings	25 35 30	10 15 20	of the Republic of Belarus
	Administration and amenity buildings	35	20	
	Storage areas for motor vehicles open and covered areas for motor vehicles	20	10	
	Up to the roadway edge of enterprise's highways	15	10	
	Storage areas for motor vehicles designed for dangerous goods of 1, 5–7 classes and 9.2 underclass, as per GOST 19433	100		
Bosnia and Herzegovina	Gas tanks from crowded places	100		“Narodne novine”, broj 93/98., 116/07. i 141/08, PRAVILNIK O POSTAJAMA ZA OPSKRBU

Country	Name of buildings, structures and outdoor units of motor carrier	Distance from LNG stations (in meters)	Distance from CNG stations (in meters)	Source of requirements
	Gas tanks from buildings	15		PRIJEVOZNIH SREDSTAVA GORIVOM ("Official Gazette", No.93/98, 116/07 & 141/08, RULES ABOUT STATIONS FOR FUEL TRANSIT)
Bulgaria	Gas tanks from transformers	40 (for closed premises) 60 (on open places)		Naredba No.Iз-1971 dd. 29.10.2009 (Order No.Iз-1971 dd. 29.10.2009)
	Gas tanks from buildings	40	30	
	Distance between the axes of gas-filling stations	10	10	
Kazakhstan	Public buildings and structures (up to 50 m3)	40	40	ORDER OF THE MINISTER OF INTERNAL AFFAIRS OF THE REPUBLIC OF KAZAKHSTAN dd. October 9, 2017 No.673 On approval of the Safety Requirements for Gas Supply System Facilities
	Public buildings and structures (more than 50 m3)	70	70	
	Car roads	10	10	
	From the parking	3	3	
Kyrgyzstan	Underground tanks from living areas	200	200	Appendix (to the Government Resolution of the Republic of Kyrgyzstan dd. June 19, 2019 No.298) SAFETY RULES for the facilities using liquefied petroleum gases
	Shutoff device outside the station	50	50	

Country	Name of buildings, structures and outdoor units of motor carrier	Distance from LNG stations (in meters)	Distance from CNG stations (in meters)	Source of requirements
Moldova	Gas tanks from crowded places	100	100	RESOLUTION Nr. 552 dd. 12.07.2017 on the approval of the minimum safety requirements for the operation of distribution networks of combustible natural gases
	Public buildings	40	40	
	Residental buildings	20	20	
	Distance between transformers	3	3	
North Macedonia	Crowded places	30		As per ISO 16924:2016
	Public road network	0		
	From LNG underground tanks	5 (outdoor)		
	Transmission line	10		
	From tanks to filling station	4		
Romania	Crowded places	30		As per ISO 16924:2016
	Public road network	0		
	From LNG underground tanks	5 (outdoor)		
	Transmission line	10		
	From tank to filling station	4		
Serbia	From buildings	10	10	(“Sl. glasnik RS”, br. 22/2019) On technical standards for fire safety of residential and utility premises and public facilities
	From public roads	5	5	
	From the gas supply / distributor	5	5	

Country	Name of buildings, structures and outdoor units of motor carrier	Distance from LNG stations (in meters)	Distance from CNG stations (in meters)	Source of requirements
Tajikistan	From buildings	50	50	On approval of the Regulations on the specifics of licensing certain types of activities, dd. April 3, 2007 No.172, sh. Dushanbe
Turkmenistan	No practice with LNG/CNG			
Uzbekistan	From buildings	50	50	Cabinet of Ministers of the Republic of Uzbekistan Decision on the Approval of Safety Rules in the Gas Industry, March 16, 2019 Resolution of the Cabinet of Ministers No. 226.

Public Opinion Research

We have collected data about individual perception of the NGV market and government vision of the market development specificity. Three surveys are available for different market participants. You can find the links in the following table and obtain a survey. For up to date results, please, contact natural.gas@un.org.

Table 6. The description of questionnaires used

Audience of survey	Hyperlink to questionnaire
Car owners *Age, over 18* *Citizenship, over 1 year in UNECE country*	*https://forms.gle/n9eVZJTT3A5NL83k6*
Transport and energy sector experts and representatives: *taxi, freight transportation & logistics, passenger transportation, motor fuel companies*	*https://forms.gle/sw4sxUuFXvN6Ea2QA*
Government authorities and public organizations *Transport, energy, regional authorities*	*https://forms.gle/1TvxvS3e4ky4egnT8*

Taking into consideration the preliminary results of the research one can highlight some common reasons behind the respondents' answers for all questionnaires: the lack of NGV promotion and unclear public information about the advantages of natural gas as motor fuel.

The most interesting results of survey #1 are represented in the figures below. The survey covered a representative sample of individuals from the target countries. All respondents live in large cities with population over 300 thousand people. The results are valid for March 01, 2021.

Figure 25. Awareness of methane's environmental friendliness

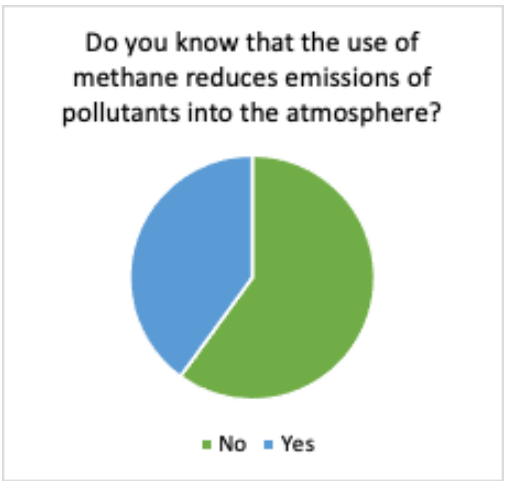


Figure 26. Reasons for switching the type of fuel

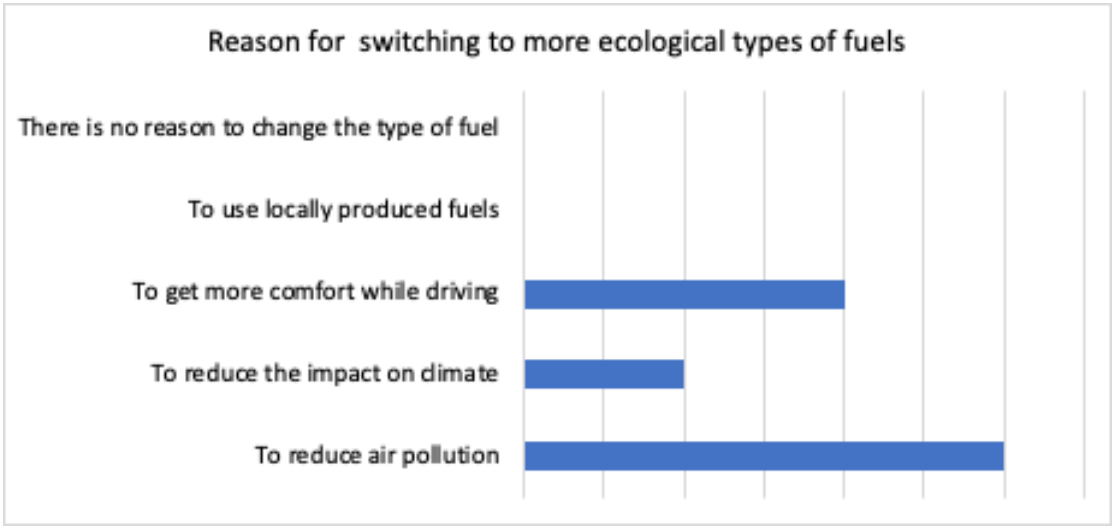
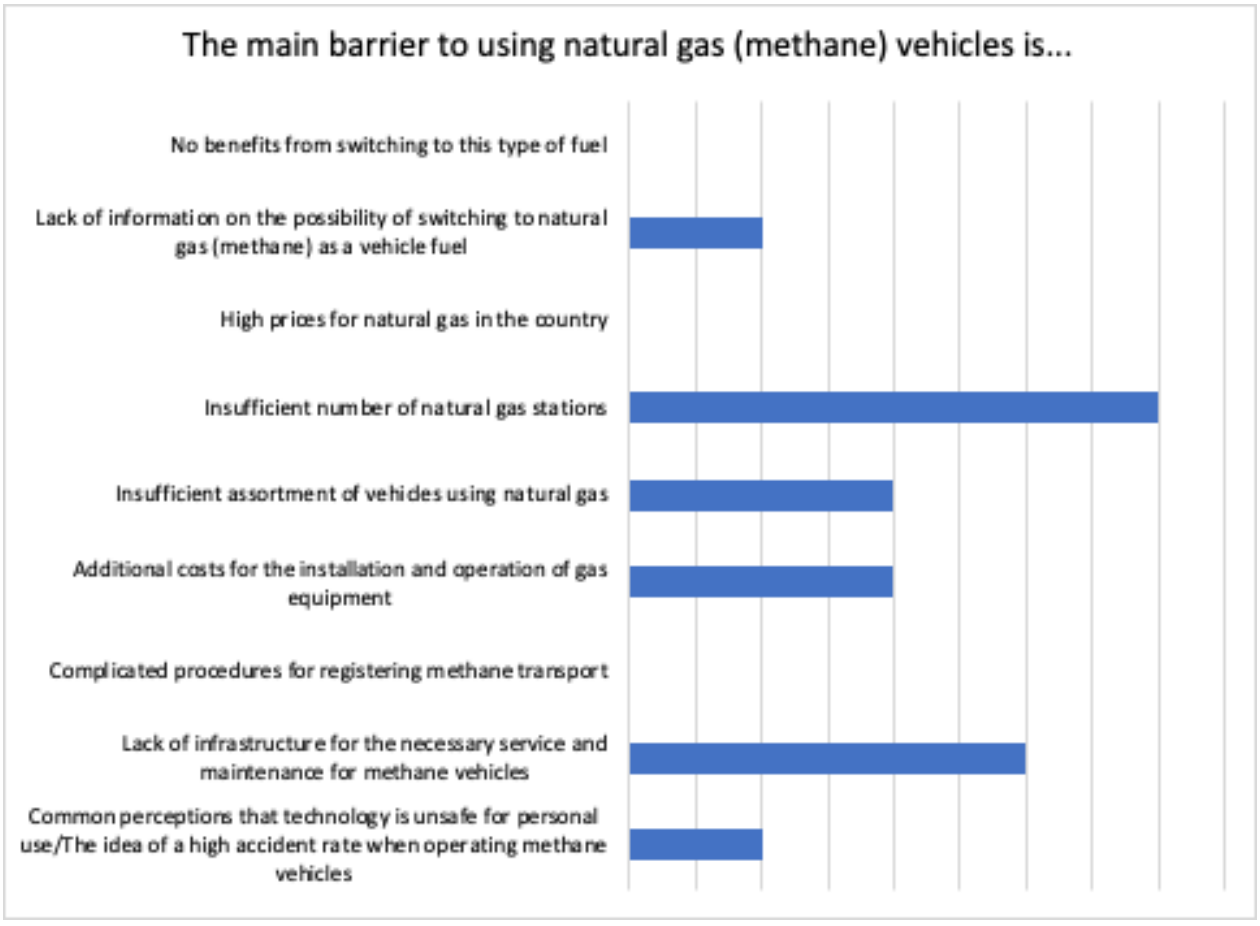


Figure 27. Barriers for NGV implementation



You can find the results of the public opinion research in Appendix 2.

NGV Case Study Analysis

Sakhalin region, Russia

According to the Paris Agreement, Russia must reduce greenhouse gas emissions by 30% compared to the 1990 level. Now the long-term development strategy with low greenhouse gas emissions until 2050 and a national plan for adapting the economy to adverse climate change are being implemented.
Sakhalin region aims to reach carbon neutrality by 2025. With the support of the Presidential Administration and the Government of the Russian Federation Sakhalin region, as an isolated island territory, becomes a territory of advanced sustainable development with low greenhouse gas emissions, a territory of international cooperation in the field of low-carbon technologies, a kind of a testing ground for piloting the best domestic and world solutions. The Government of the Sakhalin Region together with the FSBI "Institute of Global Climate and Ecology named after Academician Yu.A. Israel" is developing a regional system for monitoring greenhouse gas emissions.
Global and national energy companies, including those present on Sakhalin, are making an ever greater emphasis on reducing the carbon footprint of traditional fossil products and increasing the share of renewable energy resources in their strategies and plans; meanwhile, importing countries intend to create barriers to carbon-intensive products.
Transport is one of the main sources of environmental pollution and carbon dioxide (CO2) emissions. The share of road transport in the Sakhalin region accounts for 41% of the total emission of all pollutants into the air, and for 90% - in Yuzhno-Sakhalinsk. Therefore, the Sakhalin Region is doing its best to ensure a phased transition of vehicles to the use of natural gas.
To reduce emissions of pollutants from mobility, in 2016 Sakhalin initiated a regional program "Expanding the use of natural gas as a motor fuel in the Sakhalin" under the state program "Development of the Sakhalin Oblast Energy Industry". Sakhalin today is one of the leaders in the Russian Federation in terms of support to NGV implementation and development of natural gas filling infrastructure.
In Sakhalin, a set of regional measures has been worked out to support the retrofit of vehicles to NGV fuel and develop gas filling infrastructure:

Measures to support the conversion of motor vehicles to natural gas

- subsidy for retrofitting vehicles (100% of retrofit cost but not more than 150 thousand rubles);
- subsidy for agricultural enterprises and food industry enterprises purchasing new NGV and retrofitting existing vehicles (70-90% of cost);
- subsidy for SMEs retrofitting their vehicles (70% of cost but not more than 150 thousand rubles for one car and not more than 1.5 million rubles for enterprise);
- a 50% discount on transport tax for all types of vehicles using natural gas as a motor fuel.

Measures to support the development of natural gas station infrastructure and service centers

- allocation of land plots for the construction of CNG filling stations without bidding;
- subsidies for the cost of equipment for CNG filling stations (70% of the cost);
- subsidies for mobile natural gas fillers (90% of cost excluding VAT);
- subsidies for the cost of equipment for service centers (70% of the cost but not more than 1 million rubles per service center).

In 2020, 268.5 million rubles ($ 3.6 mln) were allocated from the regional budget to support the conversion of vehicles to natural gas and the development of CNG filling infrastructure, including:

- retrofitting of individuals' vehicles - 92.8 million rubles;
- retrofitting of enterprises' vehicles - 71.3 million rubles;
- development of CNG gas station infrastructure - 104.4 million rubles.

These measures make the conversion of vehicles to natural gas more affordable for Sakhalin residents and to increase the number of natural gas vehicles. Today about 1.5 thousand vehicles use natural gas as a fuel on Sakhalin.

Within 5 years the results of the «Expanding the use of natural gas as a motor fuel in the Sakhalin region» program are as follows: 3 CNG filling stations were opened, 7 CNG stations were purchased, 1.5 thousand vehicles were converted (0.7% of the total number of vehicles in the region).

In accordance with the instructions of the Government of Sakhalin Region, it is planned to transfer 50% of vehicles in the region to environmentally friendly fuels by 2025, which will amount to about 100 thousand units.

Belgorod region, Russia

Under the support of the Ministry of Energy of the Russian Federation and Gazprom, PJSC the roadmap for the advanced development of the NGV market in 2019-2021 was developed. Belgorod Region launched a pilot project to develop the NGV market in February 2019.

A working group includes representatives of Belgorod administration and businesses.

The pilot project is being implemented in three main areas:

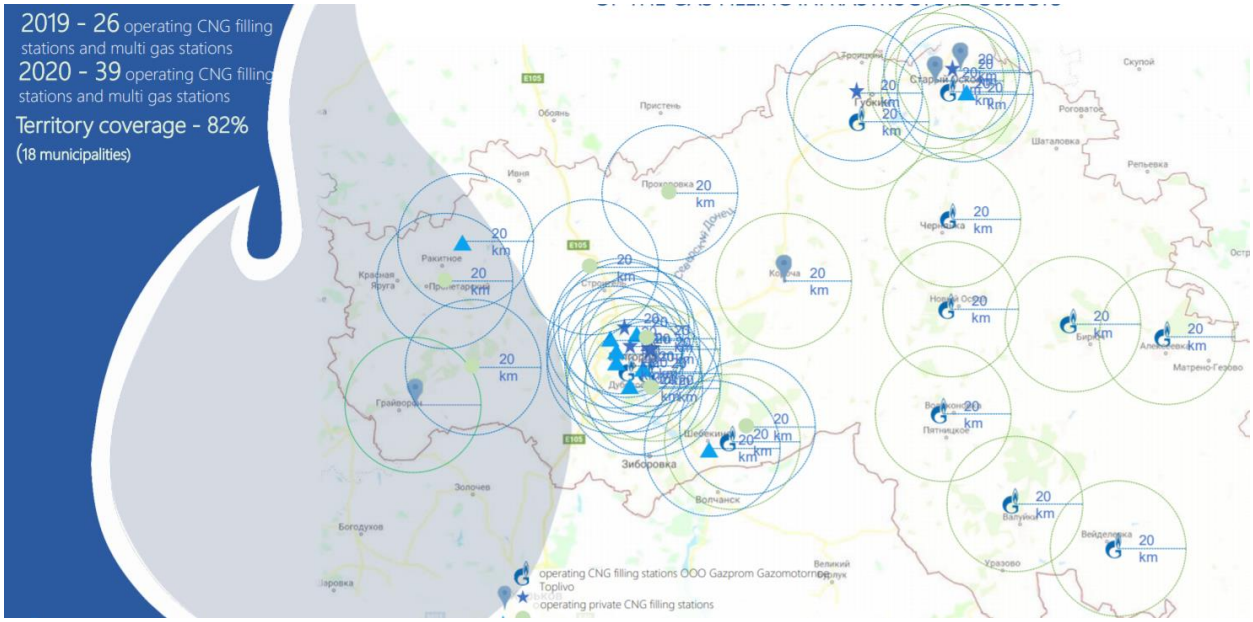
1. Gas station infrastructure development.
2. CNG retrofit of the vehicles.
3. Governmental incentives for key players of the NGV market.

The Government of Belgorod Region, in cooperation with the operators of automobile gas-filling compressor stations, has developed a program for the development of the NGV market until 2025 and a plan for territorial distribution of gas-gas station infrastructure facilities. The plan was worked out with regard to the need for up to 200 million cubic meters NGV fuel; the filling stations are to refuel up to 50 thousand vehicles per year. The planned density of the CNG filling station is: 1 station for 38 thousand people.

The Federal incentive of the Ministry of Energy foresees for a 2 times higher discount for small business and individuals for vehicle retrofit.
As for today the regional authorities have transferred more than 65% (1150 units) busses on CNG. The overall plan is to retrofit 70% of regional fleet up to 2021.
The key federal incentives of NGV market are as follows:

1. Provision of a subsidy for a CNG filling station construction - up to 40 million rubles per one CNG station ($ 500 000).
2. Complementary subsidies, up to 60% of the retrofit cost to Gazprom's programs for gas engine fuel that compensate up to 90% of the costs.
3. Land plots for the construction of CNG filling stations are leased out without bidding.
4. The legislature of Belgorod region has passed a regulation on relevant tax incentives :
   - a 50% transport tax cut for the owners of duly registered vehicles equipped to use natural gas as a motor fuel;
   - a preferential property tax for organizations implementing investment projects for the construction of automobile gas filling compressor stations and cryogenic automobile filling stations for liquefied natural gas, as well as for the modernization of automobile filling stations in terms of equipping them with modules for refueling vehicles with compressed natural gas (0.5% - for the first year;1% -for the second year; 1.5% -for the third year).
5. Key regional incentives for NG projects.
   - 50% land tax cut for legal entities - owners of CNG stations and multi gas stations; when announcing tender procedures for passenger transport services, priority is given to vehicles using NGV fuel; parking spaces are provided on preferential terms (50% discount).

Figure 28. CNG stations in Belgorod region



All these measures are designed to solve an ambitious task: to create the necessary gas station infrastructure of 39 CNG filling stations and 20 centers for the retrofit and maintenance of natural gas vehicles, and thus, by the end of 2021, to increase the number of Belgorod methane-powered vehicles to 20 thousand cars and reduce emissions from transport by 10%.

Republic of Tatarstan, Russia

In 2013, under an agreement between PJSC Gazprom and the government of Tatarstan[4], a pilot project was launched in the republic to expand the use of natural gas as a motor fuel.

Under the terms of the agreement, PJSC Gazprom is developing the gas station infrastructure; with federal support the region is to purchase and convert equipment to gas motor fuel.

Thus, the Republic of Tatarstan with a population of 3 million people and transport fleets of 1 million units has become one of the 10 pilot regions of the Russian Federation for the development of the NGV market. The announced budget of the program is 11 billion rubles.

The reasons behind the decision to transfer of equipment to gas motor fuel were: the deterioration of the environmental situation due to the growth of the fleet of vehicles; the need to cut dawn fuel costs; the presence of enterprises for the production of vehicles and gas cylinder equipment.

The 10-year program[8] was to be implemented in three stages:

At the first stage (2013), basic tools were developed for the operation of the NGV market:

- the legislative base has been formed;
- forms of cooperation and support with federal executive authorities have been determined;
- mechanisms of state support have been developed, in particular, partial compensation for re-equipment or purchase of a vehicle at GMT;
- primary purchases of vehicles operating at GMT were carried out;
- information campaigns were carried out to support the replacement of vehicles with GMT;
- the maximum load of existing CNG filling stations on the territory of the Republic of Tatarstan was ensured;
- new CNG filling stations were designed;
- training in the use of GMT were organized

At the second stage (2014–2018), the production of vehicles and their maintenance in parallel with the purchase of vehicles running on CNG (up to 50% of the republican equipment in certain categories) were foreseen; the existing capacities of CNG filling stations and the number of the new stations under construction were taken into account.

Training in the use of GTM and information support for the transfer of vehicles to GTM remained the priority areas.

The main objectives of the II stage were as follows:

- more than 5,085 vehicles powered by CNG were purchased;
- the existing CNG filling stations reached the maximum loading - 195.5 thousand cubic meters per day;
- 31 CNG stations (design capacity: 120 cubic meters per day) and 65 subsidiary CNG stations (design capacity: 2 CNG stations, 4000 cubic meters each with a hydroelectric station) were launched;
- 682 new jobs were created.

The third stage (2019–2023) will expand the use of natural gas, as well as the necessary infrastructure for vehicles running on CNG, the conversion and operation of cars, trucks and buses on CNG.

The main objectives of the III stage:

- To purchase 8,825 vehicles powered by CNG;
- To construct 29 CNG stations (design capacity: 120 cubic meters per day) and 85 subsidiary CNG stations (design capacity: 2 CNG stations of 4000 cubic meters each with a hydroelectric station)
- To create 818 new jobs.

As of 2021, 24 CNG stations and 2 CAPPs were built in the Republic, 9 thousand units of equipment were transferred or purchased, of which 2,000 were state and municipal vehicles. The efficiency of the transition of vehicles from traditional fuel to methane amounted to more than 5.5 billion rubles, with the annual savings of 60 million rubles.

Local manufacturers have mastered a new line of NGV equipment for various purposes.

Bogota, Colombia[1]

The diesel-powered public buses and heavy vehicle are the main sources of severe pollution. Heavy air pollution in the largest city of Colombia has raised environmental concerns and forced the city government to declare the state of emergency.

Buses used diesel that resulted in significant pollution, and in order to improve the air quality the city authorities had to concentrate on reducing the emissions from these vehicles as their first priority .

The bus rapid transport system (BRT) – Transmilenio has greatly contributed to the improvement of the situation .

The city of Bogota and Transmilenio renewed 70% (1,400 vehicles) of the city fleet. 53% (a total of 741 units) were replaced by Euro VI compressed natural gas (CNG) vehicles, and the rest are to be powered by Euro V diesel vehicles with particulate filters that can absorb 75% of particulate emissions (a total of 650 vehicles). This initial switch was completed in May 2020 so the 741 CNG buses are already operative in Bogota.

Many factors and actors have promoted the emerge of the largest Euro VI CNG fleet in Bogota. Some of those can be highlighted as follows.

Technological availability. Previous work done with Scania (since 2014) for the configuration, testing and operation of Euro VI CNG Biarticulated buses allowed

the bus operator companies to have technical support and credibility for this product. The long-term vision developed by this manufacturer has made it the only available supplier with EURO VI technology for this bidding process.

Tax incentives. The government of Colombia has implemented a robust tax benefit system that made cleaner technologies more competitive. Tariff reduction, VAT exemption and corporate tax credits allowed to cut down the cost of a state-of- the-art technology and made it competitive in comparison to Euro V diesel buses.

Competitive technology cost. In 2018, Scania decided to offer only natural gas technology for bidding in the city of Bogota. Pursuing a significant growth of its market share in the country, it adjusted its profitability levels and leveraged the VAT exemption benefit by assuming the risk of presenting the offer without the VAT. The latter made the cost of the Euro VI CNG buses competitive to the values of the Euro V Diesel fleet offered by competitors.

Long-term CNG contracts. Vanti-Gas Natural, the CNG trader, seeks to enhance the long-term competitiveness of the bus operation companies. To achieve this goal it offers a stable CNG price and guarantees a ten-year contract and gas availability. Stable CNG prices and significant cost reduction compared to the cost of Diesel fuel (up to 30%) make CNG technology more cost-efficient and pronotes a positive externality for Bogota.

Communications strategy. The appropriate use of communication channels, the right support from the gas association, the position of the civil society throughout the bidding process made it possible to choose the technology that improves air quality.

The environmental benefits of this technology will be obvious in 10-years. The analyses of emissions carried out by the Universidad Nacional de Colombia shows that the reduction in emissions expected in the forthcoming 10-year will provide an environmental benefit of more than 1,019,557 Ton CO_2, 11 Tons of particulate matters and 9,594 Ton of NO_X.

New vehicles will reduce the environmental impact of Transmilenio, improving the air of the city by reducing emissions of particulate matter (PM) and Nitrogen Oxide (NOx), by more than 99%. The expected reduction of harmful emissions was beyond all expectations (falling by more than 50%).

Bengaluru, India

In order to boost the clean fuel ecosystem in Bengaluru GAIL Gas Limited, a wholly owned subsidiary of GAIL (India) Limited, has entered into a strategic partnership to promote the usage of CNG in the garden city. A Memorandum of Understanding (MoU) was signed between the two companies during the inauguration of a GAIL Gas CNG Station at Hardware Technology Park, near Bengaluru airport**.**

As part of this partnership, named “Hasiru Bengaluru” or “Green Bengaluru”, GAIL Gas CNG Stations and Uber will promote the adoption of cleaner fuels like CNG in Uber cars in Bengaluru. As part of the agreement, GAIL Gas will provide free CNG to the first 500 cars joining under the program, capped at a maximum of Rs. 10,000

per car. GAIL Gas will be extending coupons to each of the participating Uber driver partners for Rs. 2500 per month for the first four months.
Uber will provide a joining award of Rs.10,000 to the first 500 CNG vehicles driving with the platform. Uber will in turn, create awareness among its driver partner community on the benefits of CNG through several channels. In order to promote cleaner fuel vehicles, GAIL Gas & Uber will keep in touch with OEMs, auto dealers and retrofitters.
The GAIL Gas CNG station was opened at KIADB Hardware Technology Park, near Bengaluru Airport alone has a capacity to fuel approximately 1000 vehicles a day. The station has two compressors with 1200 SCMH capacity each and four dispensers for refilling cars and autos. These dispensers can refuel 8 vehicles simultaneously.
For potential and current driver partners of Uber, CNG is expected to cut dawn monthly expenses up to ~Rs 15000 (about 200 USD)**.**
To optimise uptake of CNG and improve accessibility to the fuel for Bengalureans, GAIL Gas is also making CNG available through Retail Outlets of other Oil Marketing Companies. There are six operational CNG stations at Laggere (Prem Nagar), APC Circle (Jigani), Peenya Industrial Area , Sungadkatte, Bommasandra Industrial Area in the city. Upcoming CNG Stations include Agara, KR Puram, Goravigere, New Airport Road, Tata Nagar, Sarjapur Road. Overall, to cater to the demand and facilitate a strong ecosystem, 20 new CNG stations were put into operation in March 2019.
With diesel and petrol prices rising, CNG presents an affordable and environment friendly alternative. The cost of CNG in Bengaluru is Rs. 51.27 per kg. For vehicle owners, this can cut down the costs by about 60 % compared to petrol, and by 50% compared to diesel and approximately 45% compared to auto LPG. For Uber drivers using CNG may result in monthly savings upto Rs 15,000.

Table 7. Estimation of CNG savings

	CNG	**Diesel**	**Monthly Saving**	***Rationale behind estimates***
Fuel Cost	Rs 2.1 per Km	Rs 4.8 per Km	Rs 10000	Rs 2.7 per km difference (4.8-2.1) Estimate - 145 km travel per day -- driving approximately for 10 trips Assuming Avg speed in BLR at 20kmph so approx 7 hrs of driving time
Maintenance	Rs 2000	Rs 4000	Rs 2000	Comparison of average costs for popular diesel cars versus a WagonR CNG car for demonstration purposes
EMI	Rs 13500	Rs 16000	Rs 2500	Comparison of average EMIs for popular diesel cars versus a WagonR CNG car for demonstration purposes

Recommendations

The overview of the NGV markets in the target countries, as well as the analysis of the best practices of regional state regulation allowed to formulate some common key principles that can be presented as recommendations for all UNECE countries.

1. The rational choice of the transport transition direction connected to the energy transition. BEV can be an option for decarbonization if coal does not prevail in the power mix of a country. That is why we recommend to conduct a special research of power mix for every target country within the framework of the project. This study will provide a basis for BEV life cycle analysis and comparison with NGV environmental effects in every target country.
2. Each country should have a comprehensive development program for the NGV market including different segments of the transport sector: private cars, buses, LCVs, heavy trucks, construction and communal machinery, agricultural and quarry machinery, railway transport, water transport etc. A comprehensive development program should include a layout for gas station infrastructure (CNG and LNG) with pipeline connection and supporting infrastructure (cylinder inspection centers, service centers, retrofitting points etc). The layout should be based on the potential demand research for different segments of the transport sector. In areas with low natural gas network coverage it is advisable to consider the possibility of creating an infrastructure for small-scale LNG and start the transition from commercial segments of transport sector, primarily long-distance heavy trucks and machinery. The pilot project aimed at creating a comprehensive development program for one of the developing NGV markets in UNECE target countries can become a meaningful result of the UNECE project.
3. Technical regulation requires harmonization between different countries. As UNECE countries connected with highways and possible CNG and LNG ‘corridors’ we propose to initiate the creation of a unified interstate register of cylinders to control their circulation and simplify procedures for the end user when crossing borders.

Potential customer does not know a lot about the NGV opportunity. Most of the existing NGV video-materials are of a good quality entertainment but they should be updated to meet modern standards and be globally promoted. EV vehicles are well supported by global promo and charismatic business leaders. We propose to to create video-materials clarifying the specifics of NGV fuel in UNECE countries in partnership with industrial associations of the respective countries.

Conclusions

Natural gas for vehicles can be an effective solution for transport transition. It meets at least 8 UN 2030 SDGs and allows to balance social, environmental and economic factors. The basic qualities that make natural gas attractive are:

- The cost of natural gas is lower than gasoline or diesel;
- The cost of NG vehicle ownership is also relatively low;
- Natural gas cannot be stolen from the vehicle unlike gasoline or diesel;
- Usage of natural gas as a motor fuel for water transport allows to avoid fuel spills;
- Natural gas allows to decrease GHG emissions and to get rid of the most harmful substances absorbed by particulate matter;
- The use of biogas from municipal and agricultural waste allows to implement a comprehensive approach to solving environmental problems;
- The transition to e-mobility implies a mandatory change in the power mix, while the transition to NGV does not require investments in power generation;
- CNG and LNG technologies are mature and can be easily implemented in medium-term,
- Existing vehicles can be converted to use natural gas in a short time.

Every UNECE country can choose the model of transport transition based on its power balance, access to natural gas network and perspectives of energy sector. Most of the target countries have got the basic conditions for rapid development of the NGV market:

- Big difference in CNG and gasoline prices,
- High natural gas network coverage,
- Obvious need in declining emissions,
- Barriers for rapid energy sector development.

There are several main steps for regulatory authorities to start with:

- to make a complex analysis of transport and energy sectors and specify the fuel potential of every segment of transport sector,
- to understand the perspectives of power mix in the long run,
- to develop a comprehensive program of NGV market development with an infrastructure layout based on potential demand,
- to initiate simplification of technical regulation for filling stations,
- to develop a system for cylinders turnover monitoring,
- to implement a program for popularization NGV among citizens.

Industrial associations should exchange the best practices of supporting NGV market worldwide. If you have any specific questions about the NGV market development and the implementation of the best practices, please do not hesitate to contact natural.gas@un.org.

Endnotes

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Appendix 1. Video-materials

There are some leading countries in NGV deployment worldwide. China, India, Germany, Russia, South Korea promote NGV market intensively. Promo videos supporting CNG and LNG deployment are presented in the table below.

Table 8. The list of video materials about NGV

	Title/hyperlink	Short Description	Country	Views, thousand
1.	**Natural gas vehicle** https://www.youtube.com/watch?v=oaahuffEDgk&feature=youtu.be	Cartoon explains the ecological benefits of NG for children. Duration: 5 minutes 2017	South Korea	300
2.	**CNG - Energizing the Roads with #happyfuel** https://www.youtube.com/watch?v=pxmF-X2wTBc	Entertainment video, a couple explains the ecological and economic benefits on Natural gas. Slogan: Shift to natural gas Duration: 1 minute 2018	India	86
3.	**CNG - the ideal transportation fuel** https://youtu.be/pxmF-X2wTBc	Cartoon explains economic and ecological benefits of Natural gas. Slogan: if you care, change the air Duration: 3 minutes 2018	India	0.9
4.	**Hawa Badlo - Switch2Swachh** https://youtu.be/DIrx4ytV87g	Dynamic city movie. Gail attracts attention to air pollution in Delhi and popularize CNG as an option. Duration: 3 minutes 2018	India	216
5.	**Gas use in vehicles** https://www.gazprom.com/about/production/ngv-fuel/	Gazprom gives profound vision on NGV market, attracting to economic and ecological outcome of NGV transition. Duration: 30 minutes	Russia	n/d
6.	**EcoGas – new fuel brand of Gazprom** https://www.youtube.com/watch?v=Tpb8HYuMAOA	EcoGas brand promo (Russian language) Duration: 1 minute	Russia	n/d
7.	**NGV usage** https://www.youtube.com/watch?v=bRgLRs_VQvw	Eco GAS explanatory video about Nnatural gas as motor fuel usage Duration: 1.5 minute 2015	Russia	900

	Title/hyperlink	Short Description	Country	Views, thousand
8.	**LNG alternative** https://www.liqvis.com/homepage.html	Uniper and Iveco joint LNG promo Duration: 2.5 minutes	Germany	n/d
9.	**The Safety of Compressed Natural Gas (CNG)** https://youtu.be/CcayDbdVXHE	NGV America describes advantages with special focus on Safety of usage. Duration: 4.5 minutes 2015	USA	31
10.	**Fueling a CNG Vehicle** https://www.youtube.com/watch?v=HS1aGWA10GI	Fuel company Clean Energy explanatory video. Duration: 1.5 minute 2015	USA	13
11.	**How to Refuel a Compressed Natural Gas Vehicle** https://www.youtube.com/watch?v=Nv8028Up0bI	Independent expert explanatory video about refueling. Duration: 9 minutes 2017	USA	5
12.	**Bosch compressed natural gas technology** https://www.youtube.com/watch?v=ykAd7MLtj1M	Bosch promo video Duration: 4.5 minutes 2018	Germany	18
13.	**AS 24 - CNG LNG offer** https://youtu.be/GEisrE34ffc	Total company promote CNG/LNG benefits Duration: 1.5 minute 2020	UK	0.5
14.	**CNG 101: An Introduction to Compressed Natural Gas** https://www.youtube.com/watch?v=yR9XS9QxRTk	Promo channel CNG Now promotes the benefits of CNG. Cartoon style Duration: 3 minutes	USA	111
15.	**What is CNG?** https://www.youtube.com/watch?v=VPA0WyVUEMc	O&G company promotes CNG in a dynamic cartoon Duration: 1.5 minute 2019	USA	8
16.	**NGV vehicles and their benefits** https://youtu.be/I4fY0U_qMSw	Adnoc promo of CNG Duration: 2 minutes 2017	Abu-Dhabi	1.5

Appendix 2. Results of public surveys

Survey #1.

Choose the country of residence	
Kazakhstan	44%
Moldova	11%
Bulgaria	22%
Belarus	22%
Where do you live in?	
City with population over than 300 thousand people	100%
Town or suburb with population lessthan 300 thousand people	0%
Distant country side, with less than 10thousand people	0%
What is the average distance you drive every day?	
Less than 10 km	67%
10 km – 30 km	22%
30 km -70 km	11%
More than 70 km	0%
What age group do you belong to?	
18-25	33%
26-35	11%
36-45	33%
45-60	11%
>60	11%
What is your family size?	
Single	44%
Couple	11%
5 or less family members	33%
More than 5 family members	11%
What is your income level?	
Less than 150 US dollars per month	0%
150 -1000 US dollars per month	67%
More than 1000 US dollars per month	22%
Prefer not disclosure info about income	11%
Do you have or your family has a car?	
I have (or my family has) a car	44%
I had a car earlier	0%

I have no car, but I’m going to to buy	44%
I have several cars	11%
What is sufficient reason for you for switching to more ecological types of fuels?	
To reduce air pollution	50%
To reduce the impact on climate	17%
To get more comfort while driving	33%
To use locally produced fuels	0%
There is no reason to change the type of fuel	0%
What fuel is the most eco friendly?	
Gasoline	0%
Diesel	0%
Natural gas (methane)	0%
Propane-butane	0%
Electricity	80%
Hydrogen	20%
Do you know that the use of methane reduces emissions of pollutants into the atmosphere?	
Yes, I know	40%
No, I don't know	60%
I fuel my car with	
Gasoline	50%
Diesel	0%
CNG (compressed natural gas,methane)	10%
LPG (liquefied petroleum gas,propane-buthane)	10%
Electricity	30%
I agree that natural gas (methane) as a vehicle fuel has the following benefits	
Cost is lower	43%
Fuel quality is better for the engine	7%
The volume of harmful exhaustgases is lower	29%
I don't think natural gas has any advantages	0%
I don't know	21%
I am considering installing a methane fuel system on my car	
Yes, if additional filling stations appear	40%
Yes, if I receive a subsidy	60%
Yes, if the vehicle registration procededures become easier	0%
No, under no circumstances	0%

I am considering buying a new car that uses natural gas (methane) as a motor fuel	
Yes, if car dealers are more active offering CNG models	44%
Yes, if additional filling stations appear	31%
Yes, if I receive a subsidy	25%
No, under no circumstances	0%
The main barrier to using natural gas (methane) vehicles is	
Common perceptions that technology is unsecure	6%
Lack of infrastructure	63%
Complicated procedures for registering CNG vehicle	0%
Insufficient assortment of vehicles using natural gas	13%
High prices for natural gas in the country	0%
Lack of information	19%
No benefits from switching to this type of fuel	0%
Do you remember any information campaigns supporting the use of natural gas in transport?	
Yes, there was a governmental campaign	10%
Yes, there was a corporate campaign	30%
No, I don't remember any campaigns, didn't pay attention	20%
No, there are definitely no campaigns in my country to support the use of natural gas (methane) in transport	40%
Do you feel a lack of information about the natural gas as a motor fuel?	
Yes, I would like to know more about existing fuel alternatives	50%
Yes, I am interested in the use of natural gas in transport	30%
No, I have access to sufficient information	20%
No, this question is not interesting to me	0%

Survey #2

Choose the country of residence	
Uzbekistan	79%
Bulgaria	7%
Kazakhstan	7%
Moldova	7%
Do you work in the transport sector?	
Yes, I am a car dealer	0%
Yes, I am selling motor fuel	7%

Yes, I am selling related services for transport	0%
I am engaged in the production / sale of equipment and components for transport	0%
I am engaged in passenger transportation	0%
I am engaged in cargo transportation	0%
No, I work in non-transport sector	93%
Indicate your status	
Business owner	0%
Director of the enterprise	0%
Middle manager	27%
Employee	60%
Entrepreneur / self-employed	0%
Other	13%
What opportunities associated with the transition to the use of natural gas (methane) are potentially interesting for your business?	
Savings on fuel due to the lower price of natural gas compared to gasoline and diesel	38%
Reduction of engine wear due to the physical properties of natural gas	8%
Exclusion of inappropriate use of fuel by employees of the enterprise (methane cannot be “drained” from the tank)	21%
Reducing the level of harmful emissions during the operation of transport	21%
No opportunities	13%
Are you considering the possibility of using alternative fuel vehicles in your business?	
Yes, to increase economic efficiency	41%
Yes, to strengthen the image component	12%
Yes, within the framework of the sustainable development strategy	12%
Yes, based on regulatory requirements	0%
No, it is not relevant to my business	12%
Other	24%
What alternative fuels do you find attractive for your business?	
CNG (compressed natural gas, methane)	22%
LNG (liquefied natural gas, methane)	26%
LPG (liquefied petroleum gas, propane-butane)	4%
Electricity	35%
Hydrogen	13%
Are you personally or your business interested in the development of NGV fuel in your country?	

Yes, I am interested, ready to participate in specialized events	36%
No, I am not interested, I have no business interests	64%
Do you think that natural gas (CNG, LNG) will become a common motor fuel in your country?	
Yes, for all types of transport	47%
Yes, for freight road transport	13%
Yes, for passenger cars	7%
No, it will not be for any type of transport	7%
I don't know	27%
What are the barriers to the spread of natural gas as a vehicle fuel in your country?	
Insufficient government support measures for the acquisition of NGV equipment or for the conversion of existing equipment to NGV fuel	14%
Insufficient motivation of all market participants to switch to new technologies	19%
The current technical regulations restrict the development of infrastructure and re-equipment of transport	0%
Lack of a wide range of natural gas vehicles	14%
Lack of necessary natural gas refueling infrastructure	10%
Current natural gas prices are too high	5%
Other	38%
Do you think your country has effective campaigns for sustainable modes of transport?	
Yes, in support of electric transport	18%
Yes, in support of the transfer of freight transport to natural gas	6%
Yes, in support of the transfer of passenger cars to natural gas	6%
I am not aware of any such campaigns	12%
Campaigns are running, but I cannot assess their effectiveness	35%
Other	24%

Survey #3

Choose the country of residence	
Kazakhstan	29%
Armenia	14%
Bulgaria	14%
Moldova	14%

Romania	14%
Bosnia&Herzegovina	14%
You are a representative of	
Political party	0%
Authority	29%
Public organization	57%
International organization	14%
Is there a need in your country to transform the transport sector?	
Yes, but no more than within the framework of the ratified international obligations	0%
Yes, the transport sector requires significant changes due to economic factors	27%
Yes, transformation of the transport sector is needed due to ecological factors, in particular to improve the quality of the urban environment and improve air quality	55%
Yes, I see a potential competitive advantage of the country in the use of new technologies in transport	18%
No, there are some other priorities in the country	0%
What issues are the highest priority for your country (choose 1-3 answer options)?	
Ensuring the availability of public transport for the general population	14%
Increasing the competitiveness of the transport sector by reducing the cost	24%
Reducing harmful emissions and improving the quality of the urban environment	24%
Introduction of the most modern technologies and strengthening of the country's image	10%
Increasing the use of domestic products	5%
Increase in the share of provision of the population with personal transport	0%
Reduction of public spending on transport and fuel	5%
Development of transport and refueling infrastructure throughout the country	19%
Creation of transport companies able to compete in the regional / global market	0%
What transport sector transformation programs do you find relevant for your country?	
Support of the alternative fuels	32%
Transparency and competition	9%

Introduction of unmanned technologies	0%
Implementation of the “sharing” economy model	0%
Optimization of logistics and production processes	5%
Infrastructure development	27%
Creation of new production facilities for equipment and technology	14%
Increasing the availability of transport through financial instruments	14%
What motives, in your opinion, are decisive for personal car owners when switching to alternative fuels?	
Convenience and comfort of use	9%
Fuel cost	30%
Assortment of vehicles in the line of car manufacturers	4%
Financial incentives from the state	17%
Operational safety	9%
Availability of the necessary filling and service infrastructure	26%
Impossibility of inappropriate fuel consumption	0%
The ability to install an additional alternative fuel system on an existing car	4%
Environmental friendliness	0%
Image and public opinion	0%
What motives, in your opinion, are decisive for transport companies when switching to alternative fuels?	
Convenience and comfort of use	4%
Fuel cost	25%
Assortment of vehicles in the line of car manufacturers	4%
Financial incentives from the state	13%
Operational safety	4%
Availability of the necessary filling and service infrastructure	21%
Impossibility of inappropriate fuel consumption	4%
The ability to install an additional alternative fuel system on an existing car	8%
Environmental friendliness	8%
Image and public opinion	8%
If we consider alternative fuels, which of them seem to you the most promising for passenger cars?	
CNG (compressed natural gas, methane)	13%
LNG (liquefied natural gas, methane)	20%
LPG (liquefied petroleum gas, propane-butane)	20%
Electricity	27%
Hydrogen	20%
Considering alternative fuels, which ones do you think are the most promising for commercial freight vehicles and passenger cars?	

CNG (compressed natural gas, methane)	29%
LNG (liquefied natural gas, methane)	29%
LPG (liquefied petroleum gas, propane-butane)	18%
Electricity	18%
Hydrogen	6%
Does your country have formal goals and targets for transforming the transport sector using alternative fuels?	
As far as I know, there are no such plans	20%
There is a transport sector development program that includes targets for the use of alternative fuels	20%
There are instruments of state support for the development of infrastructure for refueling with alternative fuels	10%
There are instruments of state support for the development and production of transport using alternative fuels	20%
There are instruments of state support for consumers of alternative fuels	10%
There is an approved action plan for the development of infrastructure for alternative fuels and transfer of transport to the use of alternative fuels	20%
Do you think that natural gas (CNG, LNG) will become a common motor fuel in your country?	
Yes, for all types of transport	43%
Yes, for freight road transport	43%
Yes, for passenger cars	0%
No, it will not be for any type of transport	0%
I don't know	14%