Green Finance and Investment

Promoting Clean Urban Public Transportation and Green Investment in Kazakhstan

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Please cite this publication as:
OECD (2017), *Promoting Clean Urban Public Transportation and Green Investment in Kazakhstan*, Green Finance and Investment, OECD Publishing, Paris.
https://doi.org/10.1787/9789264279643-en

ISBN 978-92-64-27963-6 (print)
ISBN 978-92-64-27964-3 (PDF)

Series: Green Finance and Investment
ISSN 2409-0336 (print)
ISSN 2409-0344 (online)

Revised version, July 2018
Details of revisions available at: *http://www.oecd.org/about/publishing/Corrigendum_KAZ_Transport.pdf*

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Foreword

This report presents the main findings and conclusions from the project on "Promoting Green Growth and Low-Carbon Development: Analysis and Support to Policy Dialogue on Key Governance Elements of the Green Economy Concept in Kazakhstan", implemented within the framework of the OECD-Kazakhstan Co-operation Programme and the GREEN Action Task Force, for which the OECD provides a secretariat.

The main objective of this work was to assist the Ministry of Energy of Kazakhstan to design a green investment programme that will be financed by public funds, with the purpose of stimulating demand for green investments in the country. The focus of the investment programme is on reducing air pollution and greenhouse gas (GHG) emissions from the public transport sector. Two cities were identified to participate in the first, pilot, phase of the investment programme, Kostanay and Shymkent. In a second phase, the programme is designed to be extended to cover the major urban centres in the country.

The report draws not only on the extensive review of environmental legislation – reflecting in particular that of Kazakhstan and the European Union – and technical regulations regarding public transport, but also on extensive primary and secondary data collection in Kazakhstan in the areas of environment, transport and public services.

The project contained four main activity areas and outputs: *i)* an initial scoping and analytical stage; *ii)* development of a programme costing methodology; *iii)* design of a programme in line with international good practices; and *iv)* preparation of an analytical report and training. Activity areas *ii)* and *iii)* constituted the backbone of the project, with the aim of demonstrating in practice how to use scarce public funds to incentivise the private sector to invest in clean and socially-important projects.

As part of the second activity, a model was designed to support the analysis of the programme and its development. This Excel-based tool was called Optimising Public Transport Investment Costs (OPTIC) model. The model assists in the calculation and optimisation of total programme costs, for both the public financier and private sector investors, the optimal level of the subsidy and the air pollution and greenhouse gas emission reductions that can be achieved as a result of programme implementation. The model is an analytical tool that can help the decision-making process become more objective and more transparent.

Over the course of 2016, the project team visited Kazakhstan on several occasions, and had the chance to discuss different elements of the investment programme with a number of experts from government offices in Astana, Kostanay and Shymkent, as well as with experts from various international organisations active in the country. We are grateful to all colleagues who took the time to meet and share their ideas and knowledge with us, helping us better formulate and shape the investment programme. We greatly benefited from the discussions during the stakeholder meeting held in Astana on 13-14 December 2016. We are thankful to participants for their constructive suggestions on improving programme analysis.

The project was managed by Nelly Petkova with support by David Simek (both OECD). This work, however, would not have been possible without the substantive inputs of consultants Rafal Stanek and David Toft (Kommunalkredit Public Consulting) and the national expert Bakhyt Bayanova (Center for Trade Policy and Development, Ministry of National Economy of Kazakhstan). Their commitment to this work is very much appreciated.

Special thanks go to our colleagues from the Ministry of Energy, Makpal Yesmurzina and Olga Melnik, for their help during project implementation. We would also like to particularly thank Yelena Yerzakovich (United Nations Development Programme), Aigul Kussaliyeva (Astana International Finance Center) and Yerbol Tokhtarov and Talgat Arystanbayev (KazTransGaz Onimderi) for their substantive review of the report and thoughtful feedback.

We are also grateful to Kumi Kitamori and Krzysztof Michalak (OECD) for their comments and support for this work. Inmaculada Valencia and Irina Belkahia of the OECD provided overall administrative support to the project, while Natalia Chumachenko and Lilia Kucharska translated the report into Russian. The authors would like to thank Victoria Elliot and Peter Vogelpoel for their help with editing and layout, as well as Janine Treves and Lupita Johanson who assisted with the processing of the publication.

The project was financially supported by the Government of Kazakhstan through the Ministry of Energy.

All these contributions are gratefully acknowledged.

The views expressed in this report are those of the authors and do not necessarily reflect those of the OECD or its member countries.

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Abbreviations and acronyms

AIFC	Astana International Finance Centre
AGBI	Astana Green Bridge Initiative
AKCB	Association of Kazakhstan's Car Business
API	Air pollution index
BRM	Business Roadmap 2020
BRT	Bus rapid transit
BTU	British thermal unit
CCFEA	Commodity classification for foreign economic activity
CDM	Clean development mechanism
CfP	Call for proposals
CI	Compression ignition
CIS	Commonwealth of Independent States
CNG	Compressed natural gas
COP	Conference of the Parties (to the UNFCCC)
CPT	Clean public transport
EACU	Eurasian Customs Union
EAEU	Eurasian Economic Union
EC	European Commission
EEC	Eurasian Economic Commission
EECCA	Eastern Europe, Caucasus and Central Asia
EDF	Entrepreneurship Development Fund
EEA	European Environment Agency
EEC	European Economic Community
EEV	Enhanced environmentally friendly vehicle
EMEP	European Monitoring and Evaluation Programme
EO PoK	Executive Office of the President of Kazakhstan
EU	European Union
EUR	Euro (Eurozone currency)

GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas (emissions)
GGE	Gasoline gallon equivalent
GoK	Government of Kazakhstan
IEA	International Energy Agency
INDC	Intended Nationally Determined Contributions
ICCT	International Council on Clean Transportation
IPCC	Intergovernmental Panel on Climate Change
IU	Implementation unit
JI	Joint implementation
JSC	Joint stock company
KPC	Kommunalkredit Public Consulting
KZT	Kazakh tenge (Kazakh currency)
LLP	Limited liability partnership
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
Ltd.	Limited company
LULUCF	Land use, land-use change and forestry
MAC	Maximum allowable concentration
MF	Maximum frequency
MID	Ministry of Investments and Development of Kazakhstan
MNE	Ministry of National Economy of Kazakhstan
MoE	Ministry of Energy of Kazakhstan
MTC	Ministry of Transport and Communications of Kazakhstan
MTEF	Medium-term expenditure framework
NAMA	Nationally Appropriate Mitigations Action
NGO	Non-governmental organisation
NMHC	Non-methane hydrocarbons
NPV	Net present value
OECD	Organisation for Economic Co-operation and Development
OPTIC	Optimising public transport investment costs
PCM	Project cycle management
PE	Programming entity

PI	Positive ignition
PIP	Public investment programme
PM	Particulate matter
PoK	Parliament of Kazakhstan
PPP	Public-private partnership
PSI	Pollutant standards index
RoK	Republic of Kazakhstan
SME	Small and medium-sized enterprise
TR CU	Technical Regulations of the Customs Union
TSU	Technical support unit
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
USD	US dollars (US currency)
VAT	Value added tax
WHO	World Health Organization

Units, quantities and compounds

bln	Billion
cm	Centimetre
cm^2	Square centimetre
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
dm^3	Cubic decimetre
g	Gram
kg	Kilogram
Kpvpd	Kilometre per vehicle per day
km	Kilometre
kt	Kiloton
kWh	Kilowatt hour
l	Litre
m	Metre
mg	Milligram

MJ	Megajoule
mln	Million
MPa	Megapascal
m^3	Cubic metre
NO_x	Nitrogen oxide
N_2O	Dinitrogen oxide
ppm	Parts per million
SO_2	Sulphur dioxide
t	Tonne
tCO_2	Tonne of CO_2
tln	Trillion
µg	Microgram

Exchange rates

	2010	2011	2012	2013	2014	2015	2016[a]
Tenge/USD	147.3550	146.6208	149.1125	152.1292	179.1917	221.7283	*342.9264*
Tenge/EUR	195.1606	203.8226	191.5889	201.9881	237.7395	245.9115	381.0155

Source: IMF (2016), International Finance Statistics database, National Bank of Kazakhstan.

Note: a. Average of 11 months.

Executive summary

The vehicle transport sector is responsible for 88% of greenhouse gas (GHG) emissions in the transport sector and contributes to the already high carbon intensity of the Kazakh economy. Most of the transport vehicles in Kazakhstan are more than ten years old. Cars and buses run mostly on diesel (about 80% of the fuel used) while diesel engines hardly correspond to the Euro IV standard compared to Euro VI used in Europe. These structural and technical features make vehicle transport an important contributor to the very high level of air pollution in many cities in Kazakhstan.

The government of Kazakhstan has committed to the development of energy-efficient local public transport. The Intended Nationally Determined Contribution, presented by Kazakhstan at the Conference of the Parties (COP21) in Paris in 2015, set the ambitious target of reducing GHG emissions by 15% to 25% by 2030, compared to the 1990 levels. The basic policy and regulatory framework that can support the advancement of clean public transport is in place but Kazakhstan still lags behind in the development of modern emission norms for both passenger cars as well as heavy-duty truck and bus engines.

Changing this situation will require significant resources, both private and public. However, transport fares are very low, at about USD 0.2 per ride, and the access to credit is constrained by the high interest rates on credit, ranging between 13% and 19%. Without state support or tariff increases, the modernisation of the public transport fleet will continue to lag.

In 2015, the OECD and Kazakhstan joined forces to analyse how a public investment programme can spur the development of cleaner public transport, and reduce air pollution and GHG emissions from the public transport sector in large urban centres in the country. It was agreed that the main focus of the programme will be on supporting the shift to modern buses powered by clean fuels, such as compressed natural gas and liquefied petroleum gas.

Programme analysis

The investment programme is designed to be implemented in two stages: a pilot phase (or phase 1), which covers the cities of Kostanay and Shymkent, and phase two – when the programme will be extended to cover all major urban centers in Kazakhstan.

Three project pipelines, considered both cost-effective and realistic to implement, including through the regular budgetary process, were identified for analysis and evaluation. The pipelines focus on the replacement of the old bus fleet in urban centres with modern buses fuelled by:

- compressed natural gas (CNG), where available;
- liquefied petroleum gas (LPG);
- diesel, but considering the import of Euro 5 and Euro 6 fuel (until respective fuel standards are implemented in Kazakhstan).

The project analysis shows that the use of CNG and LPG to power public transport buses will bring down operating costs and create savings, given the lower costs of these fuels compared to diesel. Improved diesel fuel, however, such as EURO V and VI, can also be viable alternatives where CNG and LPG are not available. The analysis also shows that domestic production of CNG and diesel-powered buses can be very competitive and can create additional jobs, offering further benefits in addition to replacing the outdated and depreciated domestic bus fleet.

The pilot phase of the programme, which covers the cities of Kostanay and Shymkent, is designed to run for a period of one year. It is assumed that during this phase, 200 buses in Kostanay will be replaced with modern models that run on LPG. In Shymkent, it is assumed that 100 buses will be replaced with modern CNG-fuelled engine buses. The total investments for this first pilot phase are estimated at KZT 9 952 mln (USD 29 mln).

Two scenarios for Phase 2 (extended phase) of the programme were also costed and assessed:

- Under Scenario 1, total estimated investments amount to KZT 61 526 mln (USD 179 mln), of which the public financing share amounts to KZT 30 399 mln (USD 89 mln).
- Under Scenario 2, total investment will rise to KZT 94 581 mln (USD 276 mln), and the public financier would contribute KZT 46 602 mln (USD 136 mln).

The main difference between these two scenarios is that Scenario 1 envisages that only the replacement of buses which are more than 15 years old will be financed through the programme, while under Scenario 2, the programme will support also the replacement of buses older than 10 years.

In terms of emission reductions, the most significant improvements are expected to be in NO_X emissions. Under Phase 2 Scenario 1, NO_x emissions are estimated to decline by about 1 135 tonnes a year, while under Scenario 2, the reduction is greater and is estimated at 1 723 tonnes a year. The CO_2 emissions are estimated to decline by 47 829 tonnes a year under Scenario 1, and 68 367 tonnes a year under Scenario 2.

Programme implementation

Programme implementation will require institutional arrangements that entail transparent and cost-effective decision-making. The report analyses several institutional options. There are a number of institutions in Kazakhstan which could be selected to potentially manage the programme. Whatever the choice, the implementing entity should have a degree of independence to ensure that decisions be made using rules and criteria in line with the programme objectives, and not subject to undue political influence.

There are potential financing mechanisms available in Kazakhstan that can be used to support the transition to clean public transport. It should be noted, however, that it is not necessary for the programme to be completely grant-financed. The nature of the public transport sector – in which operating cost savings can be achieved through the replacement of old fleet components with new models and the use of clean fuel – means that financing should be designed to increase investment, without having to support profitable projects that would have occurred regardless of government involvement.

Inter-ministerial co-operation is vital for the successful implementation of the programme. Such a programme can help increase the profile of the environment and climate on the transport policy agenda. In transitioning to clean public transport, the Ministry of Energy would benefit from closer co-operation with the Ministry of Investments and Development and its Transport Committee. The Ministry of Finance and the Ministry of Economy could also support the programme and contribute more effectively to achieving low-carbon mobility in the country.

Chapter 1

Programme rationale and main elements of design

This chapter lays out the rationale for and the main elements of the Clean public transport investment programme. The feasibility of such a programme and the main challenges to its implementation are also discussed.

Main elements of the Green Public Investment Programme in Kazakhstan

In preparing a public investment programme, the public financier needs to ensure that the essential individual elements of the programme should be carefully designed and put in place before the programme is launched. This chapter summarises the main elements of the Green Public Investment Programme in Kazakhstan that was designed as part of this study, and provides information on how and why the project team arrived at the solutions proposed.

The Clean Public Transport (CPT) Investment Programme is designed to be implemented in two phases. Phase 1 (pilot phase) covers two cities – Kostanay and Shymkent, and Phase 2 is extended to cover most major urban centres in Kazakhstan.

Focus of the programme

What is the main focus of the programme?

The main focus of the programme is on greening the public transport sector in Kazakhstan and encouraging low-carbon mobility by switching to modern buses that run on clean fuels.

How was programme focus determined?

Defining the focus of the programme is a political decision. In this case, the decision was made by the Ministry of Energy in discussion with main stakeholders in the country, both governmental and non-governmental.

Objectives of the programme

What are the main objectives of the programme?

The main objective of the programme is to reduce air pollution and greenhouse gas (GHG) emissions in urban centres in Kazakhstan and help achieve the Government's climate-related and environmental objectives. The programme was also designed to help replace the old bus fleet with modern buses powered with clean fuels (compressed natural gas, liquefied petroleum gas and diesel Euro V and VI). The programme also aims to support the development of domestic bus production and thus contribute to the socio-economic development of the country.

How were the objectives defined?

The objectives were defined in close co-operation with the Ministry of Energy and other stakeholders. Given the programme focus and objectives, a market analysis was undertaken to determine the need for public support in this sector. The market analysis reviews the current status of the country's existing bus fleet (ownership status, age, fuel type used), the market for compressed natural gas and liquefied natural gas as transport fuels, domestic production and import of buses, bus fares for urban transport, and the co-financing available for investment projects.

Specific programme targets

What are the specific targets of the programme?

The programme objectives are translated into straightforward and measurable numeric targets. The main programme targets are to:

- reduce CO_2 emissions in Kazakhstan in the transport sector by 1% after the pilot phase, by 7% after Phase 2, Scenario 1 and by 10% after Phase 2, Scenario 2 (compared to a 2015 baseline);

- reduce emissions of air pollutants in the public transport sector (carbon oxide – CO, nitrogen oxides – NO_x, particulate matter (PM2.5), and sulphur dioxide – SO_2) by 3% after the pilot phase, by 16% after Phase 2, Scenario 1, and by 24% after Phase 2, Scenario 2 (compared to a 2015 baseline);
- increase the ratio of new buses (i.e. less than 5 years old) used for urban public transport in Kazakhstan from the current 39% to 43% after the pilot phase, to 60% after Phase 2, Scenario 1, and up to 70% after Phase 2, Scenario 2;
- increase the annual domestic production of modern buses (compressed natural gas (CNG), liquefied petroleum gas (LPG) and Euro VI diesel) in Kazakhstan by 300 vehicles for Phase 2, Scenario 1, and by 500 vehicles for Phase 2, Scenario 2 (compared to a 2015 baseline).

To achieve these targets, the Government of Kazakhstan needs to select one of the programme scenarios, assign institutional roles for programme implementation and designate financing for it.

How were the targets defined?

The targets were defined as part of the analysis undertaken in the market study. Among others, the market study analyses the feasibility of the programme targets to be achieved. The amount of pollution reduction that could be achieved through replacement of outdated buses was determined using an Excel-based model developed for this study (called Optimising Public Transport Investment Costs (OPTIC) model). The model optimises the return on investment for service providers with the amount of subsidy required to stimulate the market, given the pollution reduction targets. This model was also used to determine the amount of financing necessary to meet the targets and to analyse if financing could be raised for the programme.

Programme timeframe

What is the timeframe for implementing the programme?

It is proposed that the CPT Programme be implemented in two phases. Before the pilot phase of the programme is launched, a preparation period will be needed to incorporate the programme into the state budget process; and to identify and apply for funding from additional financing sources (including donors), if necessary. The preparation and pilot phase will each last one year. The second phase will last five years.

How was the timeframe determined?

The timeframe was decided after discussions with stakeholders and analysis of the experience of other countries with similar publicly supported investments. This timeframe also accounts for the time needed for buses to be assembled in the country.

Programme costs

What are the costs of implementing the programme?

The pilot phase of the programme – which covers the cities of Kostanay and Shymkent – is designed to run for a period of one year. It is assumed that during this phase, 200 buses in Kostanay will be replaced with modern models that run on LPG. In Shymkent, it is assumed that 100 buses will be replaced with modern CNG-fuelled engine buses. The total investments for this first pilot phase are estimated at KZT 9 952 mln (USD 29 mln).

Two phases and two scenarios for the Phase 2 of the programme were proposed and costed. Under Scenario 1, the cost of replacing 1 827 buses (excluding minibuses) that are more than 15 years old will be USD 179 mln, of which USD 89 mln is required as public co-financing. Scenario 2 takes into account the replacement of all buses (excluding minibuses) that are now more than 10 years old. This would involve the replacement of 2 783 buses with modern vehicles powered with clean fuels, at the cost of USD 276 mln, of which USD 135 mln is required as public co-financing.

How were the costs calculated?

The OPTIC model was prepared to help plan and, in particular, estimate the costs and the environmental benefits (reduction of emissions of air pollutants and GHG) of the CPT Programme. The model estimates the costs of implementing the programme both with public and private investment.

Sources of programme financing and level of subsidy

What are the sources for financing the programme?

The CPT Programme can be financed by a mix of public funds (state and/or international) and private funds. The programme can be financed by the state budget within the medium-term expenditure framework process. In the programme preparation phase, the Government may seek to obtain additional financing from donors, if necessary.

The main source of financing will be bus operators' own financial sources (revenue, profits, commercial loans). As the new, clean buses are more expensive, bus operators most likely will not be willing to purchase clean buses. To stimulate low-carbon mobility, the Government chooses to co-finance such investments and provide a subsidy.

How was the level of subsidy defined?

Given the social nature of this investment, the OPTIC model is built to take into account the fact that the investments should generate at least a minimum return for the providers of public transport services. Thus, a social discount rate of 5% was used to determine the net present value (NPV) of the investment needed to replace an old bus. This discount rate is similar to the rate used by other public financing institutions that support similar investments. The subsidy is then determined at the level at which NPV is equal to zero. The economic significance of this calculation is that the subsidy will encourage potential beneficiaries to participate in the CPT Programme without allowing them to generate a profit based on the subsidy.

Financial (disbursement) instruments

What are the financial instruments that can be used to disburse programme resources?

The financial support can be provided in the form of:

- grant co-funding; and
- equity co-financing.

How were these instruments chosen?

Grant and public equity are traditional financial instruments that the government of Kazakhstan already has a lot of experience with. The proposed financial support schemes are easier to implement if most of the investment costs are co-financed by public sources.

Eligible project types and eligible beneficiaries

What are the eligible project types?

The main types of eligible projects that were defined to be supported through the programme include:

- Projects that aim to replace old buses that are more than 10 years old and that provide public transport services in urban centres with environment-friendly diesel models equipped with Euro VI engines, or with buses with CNG- or LPG-powered engines. Since Kazakhstan's bus fleet is ageing, the proposed pipelines are intended to support the purchase of new buses, not simply the modernisation of bus engines.
- Other investments such as studies, construction of CNG filling stations, creation of maintenance workshops for new buses, as well as additional investments that improve public transport services that accompany the replacement of buses in the three pipelines (CNG, LPG and diesel).
- Only investment projects (i.e. those involving capital outlays) are eligible for financing under the programme. The list of eligible projects will be reviewed annually by the programme implementation unit to ensure the relevance of the identified project types with regard to national environmental, climate and energy policy goals.

Other solutions, such as trams, were not included in the CPT programme pipelines because the tram networks, except in Almaty, are small or non-existent.

Who are the eligible beneficiaries?

The following types of beneficiaries are eligible to receive support from the CPT Programme:

- private public transport operators that currently provide services in eligible urban centres;
- municipal public transport operators that already provide services in eligible urban centres;
- city administration – for the preparation of necessary studies;
- providers of natural gas for CNG filling stations.

Programme implementation phase

What is needed for effective programme implementation?

Effective programme implementation requires the following elements:

- ensuring stable and predictable sources of finance for the programme;
- institutional arrangements to manage the expenditure of the programme, with sufficient resources to meet its objectives, and qualified staff and instruments to implement the programme;
- well-documented principles, rules and operating procedures for project cycle management;
- clearly defined and robust criteria for appraisal, selection and financing of investment projects;
- clearly defined procurement rules.

What does the OECD study propose in this regard?

To facilitate future programme implementation, the study has developed some supporting materials which include, among others:

- a proposal for project cycle management (PCM) procedures, including eligibility criteria, project appraisal criteria, project ranking procedures and financing rules;
- a proposal for institutional arrangements comprising three levels:
  - *Programming entity (PE):* In general, the PE is responsible for the design of the programme. The Ministry of Energy could play this role.
  - *Implementation unit (IU):* The IU is charged with the drafting of the programme's operating regulations. The unit consults with the technical support unit(s) in the drafting and use of its operating regulations. An institution such as the Astana International Financial Centre could be considered as a candidate to outsource the management of the Programme to. Another potential IU is the Zhasyl Damu Environmental Defence Fund Joint Stock Company, and for the pilot phase, the Social Entrepreneurial Corporations at the local level.
  - *Technical support unit (TSU):* The TSU provides specialised assistance, advice and expertise in the areas of energy and fuel efficiency, CNG and LGP buses, modern diesel buses and air pollution and GHG emission reductions. For example, the Alliance of Legal Entities "Kazakhstan Association of High-tech Energy-Efficient and Innovation Companies" could play this role. The Association of Kazakhstan's Car Business, as a non-profit professional association of official dealers, importers, distributors and national manufacturers of the automobile market of Kazakhstan, could also be considered. Other TSUs may be identified, as deemed necessary and prudent.

What kind of complementary policy actions are needed to facilitate programme implementation?

The key barriers to the development of clean public transport include:

- weak (diesel) engine emission norms;
- weak (diesel) fuel standards;
- weak technical inspection standards;
- weak pricing signals for the use of CNG and LPG-fuelled buses versus diesel;
- weak support to producers of clean buses.

These shortcomings should be addressed as part of programme preparation, as a prerequisite for its successful launch and implementation.

Policy attention is also needed with regard to:

- *Inter-ministerial co-operation in implementing the transport strategy.* While experience from other projects has shown that such co-operation can be difficult to implement effectively, the involvement of other ministries, in addition to the Ministry of Energy, may increase the probability of the programme's success. Specifically, clear environmental indicators (for example, related to air quality) should be introduced into the national transport strategy. Involving the Ministry of Investments and Development in this work (in particular, its Committee on Transport) can also raise the profile of environmental protection on this Ministry's policy agenda. Such co-operation could also help improve the collection and analysis of data on urban transport. At present, such data must be collected individually from each Akimat.

- *Changes in the fare system for public urban transport.* Tariffs should be designed to maximise the social welfare of both passengers and public transport providers, subject to budget and capacity constraints, as discussed below.
- *Changes in public tenders for providing public transport in urban centres.* Currently, most of the public transport operators are awarded short-term contacts. This approach encourages a short-term perspective among operators and motivates them to minimise investments in order to make a return on their investment over the period that the contract is valid for. Operators thus tend to choose cheap, old and therefore polluting buses. Shifting toward an approach with medium to long-term contracts would make it possible to award contracts to operators that invest in a modern bus fleet. This approach, together with a good fare system, regulatory improvements and financial support from the state, is more likely to lead to the modernisation of bus fleets.
- *Encouraging energy efficiency in public transport.* Fuel, and therefore cost, savings can be achieved by making the operation of public transport more efficient. For example, dedicated bus lanes can reduce the need to use inefficient mechanical braking. Eco-driving, a driving awareness technique that can reduce fuel consumption, can be introduced and promoted at schools for bus drivers.

Performance indicators

The following performance indicators for the institution managing the expenditure programme are recommended:

- number of buses replaced, 15 years or older, excluding minibuses;
- number of buses replaced, 10 years or older, excluding minibuses;
- number of LPG-fuelled buses replacing outdated buses;
- number of CNG-fuelled buses replacing outdated buses;
- number of model diesel-fuelled (Euro V or better) buses replacing outdated buses;
- number of new CNG fuelling stations;
- number of new LPG fuelling stations;
- kilometres of dedicated bus lanes;
- tonnes of CO_2 reduced per year;
- tonnes of PM10 reduced per year;
- tonnes of PM2.5 reduced per year.

Justification for the investment programme

The following is a summary of the main conclusions that emerged from the analysis in Chapters 1 to 7.

First, the regulatory review (see Chapter 4) demonstrated that the framework for replacing outdated bus fleets is in place. Depending on the number of buses on a given route, a replacement schedule is provided in the standard contract for provision of public transport services. Laws and regulations in place also provide for the introduction of more efficient models for buses, as well as more efficient and cleaner fuels. Currently, Euro IV emission standards apply to buses with petrol, gas and diesel engines. Euro V standards for buses with gas or diesel engines will come into force on 1 January 2018. The Concept for Transition to a Green Economy and Kazakhstan 2050 Strategy set out energy-efficiency targets and the development of energy-efficient local public transport, including a transition toward natural gas-fuelled vehicles for public transport.

Second, the review of the urban public transport system (see Chapter 3) showed that there are 185 transport service providers, 4 of which are municipally-owned utility companies and the rest private operators. Of the total bus fleet of 12 314 buses, including 3 555 minibuses, about half are owned by transport providers, while the remainder are leased. Nearly one-third of the buses are 10 years or older, and just over three-quarters are diesel-powered. This shows that the programme financing needs to be tailored to the private sector, or at least a public-private partnership. Given that there are significant efficiency gains to be realised from the replacement of ageing and inefficient diesel-powered vehicles, a programme should provide the necessary financial incentive to attract investment. Full grant financing is not necessary when it is possible to achieve operating cost savings through replacement of outdated buses and switching to cleaner fuels.

Third, the review of air pollution in cities revealed problems with particulate matter and smog precursors in the cities of Kazakhstan. In accordance with the air pollution index (API) scale, there are 14 cities with low levels of pollution, three cities with an increased level of pollution and five cities with a high level of pollution, namely, Ust-Kamenogorsk, Almaty, Zhezkazgan, Shymkent, Karaganda and Temirtau. The replacement of outdated buses with modern diesel-powered or natural gas-powered buses will help reduce pollution of particulate matter, as well as NO_x and SO_2 (see Chapter 3). Particulate air pollution is associated with increased cardiopulmonary and lung cancer mortality. Increased level of air pollutants carries a risk of mortality, in particular among people of over 65. Thus, the need for such a programme can also be justified from a public health standpoint.

Fourth, the overview of clean technologies and fuels in the bus transport sector (see Annex A) reviewed technologies for buses fuelled by compressed natural gas, liquefied petroleum gas, diesel (with Euro VI engines) and electricity. The review examined the main aspects of each fuel, as well as its advantages and disadvantages. Combined with the overview of the market for CNG and LPG, a programme aimed at the replacement of outdated diesel-powered engines is justified. However, as CNG is not equally distributed throughout the country, LPG should be used in regions where CNG is not available. Modern (clean) diesel engines can also be considered.

Fifth, the production and import of buses (see Chapter 5) were examined to assess domestic capacity for meeting the need for bus replacements. At present, domestic capacity needs to be expanded. Foreign suppliers, in particular from China and the Russian Federation, can be competitive, and import duties are not imposed on clean technology buses. That said, domestic production of CNG and diesel-powered buses represents a distinct purchase cost advantage and should be encouraged as a way to replace the outdated and depreciated domestic bus fleet.

In addition, the analysis showed that the average price of CNG and LPG is nearly half the average price of petrol and diesel, which are also subject to an additional excise tax. The following bus unit prices should be used as assumptions in the design of the programme:

- CNG bus (assembled domestically): KZT 46 mln (USD 134 000); discounted for large orders: KZT 35 mln (USD 103 000);
- CNG bus (imported): KZT 33 mln-62 mln (USD 96 000-181 000); discounted for large orders: KZT 23 mln-30 mln (USD 67 000-88 000);
- LPG bus: KZT 42 mln (USD 122 000); discounted for large orders: KZT 32 mln (USD 94 000);
- Diesel bus (Euro V or VI): KZT 38 mln (USD 111 000); discounted for large orders: KZT 20 mln (USD 58 000).

Sixth, a review of the available types of co-financing (see Chapter 2) demonstrated that there are public financing mechanisms available in Kazakhstan. However, it is not necessary for the programme to be completely grant-financed. The nature of the public sector – in which operating cost savings can be achieved through the replacement of old fleet components with new models and the use of clean fuel – means that financing should be designed to increase investment, without having to support profitable projects that would have occurred regardless of government involvement.

Finally, research and personal communications in Kazakhstan revealed some obstacles and opportunities specifically related to implementing a CNG support programme in the public transport sector. The study proposes optimal institutional arrangements (see Chapter 6) as well as the adoption of project cycle management procedures (see Chapter 7).

Main obstacles to implementing a CNG support programme in the public transport sector

The main obstacles to implementing a CNG support programme identified by this analysis include:

- **CNG infrastructure is not evenly developed throughout the country:** Natural gas pipelines are mostly concentrated in the south and southwest of the country and do not serve the northern parts of Kazakhstan.
- **Programme focus: CNG vs. LPG vs. diesel:** Currently, 98% of cars in Kazakhstan run on petrol, 0.1% on CNG and LNG, and the rest on diesel (UNDP, 2015). Due to the high initial costs of CNG (including both the purchase of new vehicles and the conversion of existing petrol and diesel vehicles), the private sector in Kazakhstan, individuals as well as companies, favour LPG systems (where the cost of conversion is KZT 200 000-300 000 or USD 600-900), compared to conversion to CNG, which is roughly double the cost.
- **A robust methodology and infrastructure for monitoring air pollution is lacking** – Different government entities are responsible for monitoring and collecting data on transport and on air pollution from the transport sector. As the United Nations Development Programme (UNDP, 2015) notes, Kazakhstan's Agency of Statistics does not have data on the transport sector (e.g. the number of transport companies, the amount of fuel consumed). Most of the information and data on the numbers, types and status of vehicles can usually be found at the Ministry of Internal Affairs website, as it is responsible for annual technical checks of vehicles.

- **Borrowing limits** – The upper limit of borrowing for the state is 50% of GDP. This rule is defined in the Agreement on Co-ordinated Macroeconomic Policy, one of the 18 sectoral agreements that serve as a legal basis for the Common Economic Space (CES). The agreement was signed in Moscow on 9 December 2010 in accordance with the Maastricht agreements (regulating the ceilings for annual public budget deficit, national debt and the rate of inflation) (Secrieru, 2014). The Government of Kazakhstan managed to maintain its public debt at 60% of GDP, which is among the lowest levels worldwide (Lovasz and Gizitdinov, 2012).

Main opportunities for launching a CNG support programme in the public transport sector

These opportunities include:

- **Readiness of local actors to co-operate** – For example, the gas distribution company KazTransGaz Onimderi LLP is willing and ready to support the programme by developing the CNG infrastructure in the country.
- **Kazakhstan's commitment to innovative clean energy projects** – To meet the 3% target of its energy needs from renewables by 2020 and 10% by 2030, Kazakhstan subsidises renewable energy production, to encourage investment in clean energy. The programme designed as part of this study could contribute to the achievement of these targets.
- **The national "green" policy framework** – The Government of Kazakhstan's Astana Green Bridge Initiative aims to promote green economic policies (green growth and low-carbon development) through knowledge sharing and green investment facilitation by bridging Europe and Asia.[1] Within the framework of the initiative, according to information provided to the OECD from the World Bank, a USD 25 mln fund should be set up to support green mini-projects (with up to USD 100 000 of grants or loans per project). The fund will be managed by the Department of Green Economy at the Ministry of Energy and supported by the World Bank and Global Environment Facility – with USD 10 mln each. The call for proposals should be announced in 2017 (depending on the decision of the Government of Kazakhstan). Potentially, this could be a financing opportunity for the CPT Programme.

Note

1. For more information on the Green Bridge Partnership Programme 2011-2020, see https://sustainabledevelopment.un.org/partnership/?p=2237.

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Chapter 2

Programme costs, financing and expected outcomes

This chapter provides estimates of the costs of the programme and the expected environmental and social benefits. These estimates are derived from programme objectives and possible pipelines which are discussed in detail here. The chapter also lays out the financing strategy and optimal co-financing level. The programme is designed to be implemented in two phases: i) *Phase 1, a pilot phase that includes two selected cities (Kostanay and Shymkent); and* ii) *Phase 2, an extension of the programme to cover most major urban centres in Kazakhstan.*

Programme objectives and project pipelines

The overall objective of the proposed Clean Public Transport (CPT) Programme is to contribute to national objectives related to the country's climate change mitigation efforts and the transition to green economic model of development. The programme will help toward the declared goal of reducing emissions of greenhouse gases (GHG) by 15% to 25% by 2030, compared to 1990 emission levels.[1] More significantly, however, it is designed to reduce levels of so-called "low" emissions in urban centres. The programme will aim to help reduce emissions of pollutants that form smog, such as carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter (PM).

In practice, this overall objective will be accomplished by supporting investments in replacing urban public transport buses with modern ones powered by clean fuel. The target sector for the programme is the public transport sector in urban areas in Kazakhstan.

The CPT Programme is designed to achieve the following specific objectives:

Objective 1 – Reduce emissions of hazardous air pollutants in urban areas in Kazakhstan;

Objective 2 – Reduce GHG emissions;

Objective 3 – Modernise the urban transport fleet, increasing the reliability and efficiency of public transport;

Objective 4 – Encourage the domestic market to produce, or at least assemble, modern buses and use domestic natural gas.

These objectives have been refined into specific targets, as discussed below.

The market analysis conducted as part of this study (see Chapter 5 and Annex A) proposes three project pipelines[2] to replace the old urban bus fleet with modern buses, fuelled by:

- compressed natural gas (CNG);
- liquefied petroleum gas (LPG);
- diesel Euro V and Euro VI, but considering the import of Euro 6 fuel (until similar fuel standards are implemented in Kazakhstan).

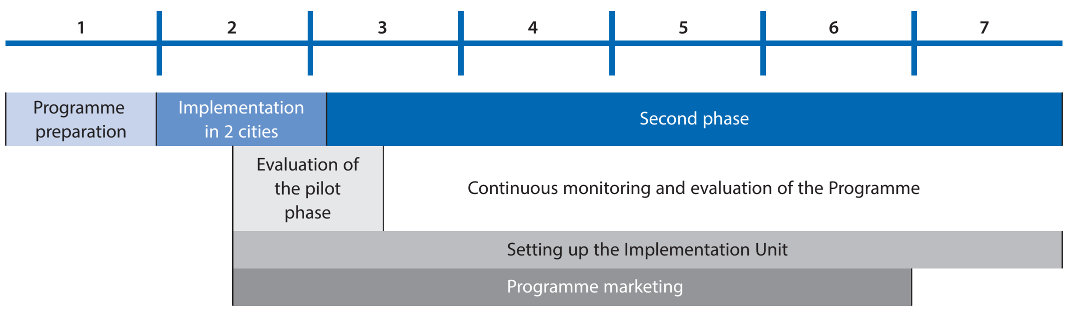
Given Kazakhstan's ageing bus fleet, the proposed pipelines are intended to support the purchase of new buses, not just the modernisation of engines. The proposed project pipelines should be accompanied by investments in CNG/LPG stations and other supporting activities – either from public or private sources – to improve the transport system in urban centres (e.g. the creation of bus lanes, improvement of bus stops and smart traffic control). Chapter 5 provides a detailed discussion of the assumptions and conclusions underlying the choice of these project pipelines.

Timeframe for implementing the CPT Programme

The CPT Programme is designed to include two phases. Before the first phase of the programme is launched, and as discussed further below, a preparation period will be needed to include the programme in the state budget process, as well as to identify and apply for funding from additional financing sources (including donors).

The first (pilot) phase will be launched in two selected pilot cities. The results will be evaluated to decide whether it will be necessary to continue the second phase implementation in additional cities. The second phase will require that a programme implementation unit (IU) be established at the national level. This unit will be responsible for the marketing of the programme, announcing calls for proposals, collecting applications, appraising and selecting projects, disbursing funds, and monitoring and evaluating the rollout and results.

Figure 2.1. **Proposed timeline**



Timeframe for the pilot phase

After discussion with stakeholders, the CPT Programme will begin with a pilot phase. When project financing is agreed on, the rollout of the programme in the two selected pilot cities will be relatively rapid, involving purchase of buses and no construction of infrastructure. The major constraint will be procurement procedures and the capacity of bus producers to deliver new buses. The pilot phase could thus take up to a year.

Timeframe for implementing the second phase

The experience of other countries with similar publicly supported investments suggests that programmes are best carried out over the medium to long term and related to government targets. It is proposed that the CPT Programme be carried out over five years and then reviewed in detail. A decision can then be made whether it should be extended or brought to a close, reflecting possible new policy objectives and government goals or market developments.

In addition, annual evaluations of the CPT Programme should be conducted, to see whether the selected and implemented projects are helping meet government objectives and to undertake remedial measures to correct the programme if necessary. Since the programme is designed to be co-financed through the state budget, any update should be co-ordinated with the existing multi-year budget/requirements. On this basis, annual financial plans for financing through the regular annual budget should be prepared.

Estimated costs and outcomes of the CPT Programme

The cost estimation is based on the Excel-based OPTIC model prepared for the Clean Public Transport (CPT) Programme (a brief description of the model is given in Box 2.1). The assumptions for cost calculation and emission reductions factors are described in Annex B in the section "Programme costing for Phase 1 (pilot phase) and Phase 2 (scaling-up phase)".

Box 2.1. The OPTIC model

The purpose of the Excel-based analytical tool, called Optimising Public Transport Investment Costs (OPTIC) model – which was developed along with this study as the main output of the project – is to support the Government of Kazakhstan in the preparation and the estimation, as precisely as possible, of the costs and environmental benefits of this green public investment programme.

The notion of a programme is understood here not solely as software but a broad area of activities required for implementing policy decisions and priorities.

The spreadsheet-based model is a simple, easy-to-use decision support tool prepared exclusively to calculate and optimise total programme costs, CO_2 emission reductions and emission reductions of other pollutants from urban public transport (CO, NO_x, PM, SO_2) that could be potentially achieved as a result of the implementation of the proposed project pipelines. The model also allows the calculation of the optimal level of subsidy that can be offered to potential beneficiaries.

Optimisation of costs and benefits implies achieving given targets at the lowest possible cost for the public financier. If underlying economic conditions in the country change over the programme period (e.g. tariffs are increased, interest rates on commercial loans are lowered) and/or available public financing is reduced or augmented both targets and subsidy levels can be further re-calculated (or optimised) and adjusted accordingly.

The model consists of seven modules: *i)* assumptions; *ii)* emission factors, *iii)* transport sector overview with information on current bus fleet and age; *iv)* determining of the subsidy level; *v)* cost calculation; *vi)* emission reductions calculation; *vii)* programme costing and environmental effects.

As discussed in Annex B, normative pollution factors declared and checked in laboratory conditions differ from actual pollution factors measured in the urban transport cycle. For this reason, the environmental outcomes of the programme were estimated using two different sets of pollution factors: normative and real. Normative emission factors take into account various modern emission standards for heavy-duty diesel and bus engines and estimations for CNG and LPG-fuelled engines. The emission factors introduced by standards, however, are based on maximum levels according to specific norms. Real emissions may vary, mainly because normative emissions are tested in laboratory conditions and not in actual traffic. This is a concern mostly for diesel engines, where emission reduction depends on the installed emission reduction equipment. In the case of CNG and LPG, emissions are less problematic because lower emissions mostly result from the use of cleaner fuels. In this case, the real level of emissions was also calculated taking into account the results published by the International Council on Clean Transportation on real-world exhaust emissions from modern diesel cars (Franco et al., 2014). Detailed discussion of emissions factors is provided in Annex B.

Phase 1 (pilot phase)

Two cities were identified for the pilot phase: Kostanay and Shymkent.

City of Kostanay

Kostanay is an ideal pilot city because it has 413 old diesel buses and only 6 relatively new ones. The old buses are more than 15 years old, most of them being 15 to 20 years old. Given the city's problems with air pollution, reducing emissions is important for its citizens.

Given that its location is far from the gas pipelines in Kazakhstan, it will be difficult to build a CNG bus pipeline in Kostanay. Since it is also close to the Russian border and not far from larger Russian cities (such as Chelyabinsk and Magnitogorsk), it is expected that better fuel options may be available.[3] On the other hand, Euro V diesel engines have already been introduced in Kazakhstan, but the experience so far has not been particularly promising, due to their higher fuel consumption and the lack of enforcement. For example, bus components intended to ensure reduced emissions from diesel engines (such as AdBlue filters) have been rapidly removed by operators because such filters entail higher fuel consumption and higher costs. The dismantling of the filters results in higher pollution levels. In this case, the best option is to replace the oldest buses with new CNG or LPG-powered models.

Availability of CNG stations is a major constraint on introducing CNG buses in Kostanay. Although one CNG station does exist in the neighbouring city of Rudniy, as reported by the oblast administration, the station is outdated. The CPT Programme envisages that the oldest buses in the city be replaced with new LPG-powered models, while a decision is made, possibly at a later stage, whether CNG, depending on its availability, will be used as a fuel rather than LPG.

Given the number of old buses in Kostanay, it is estimated that during Phase 1 (the pilot phase) 200 buses will be replaced with modern models equipped with LPG engines. The key input (financing) and output (environmental) parameters of the pilot implementation are provided in Table 2.1. The total cost of the programme for Kostanay is estimated to be KZT 6 421 mln (USD 18.72 mln), of which KZT 3 070 mln (USD 8.95 mln) will be co-financed from the programme and KZT 3 342 mln (USD 9.75 mln) will be invested by private bus operators.

Table 2.1. **Key input and output parameters of the pilot programme in Kostanay**

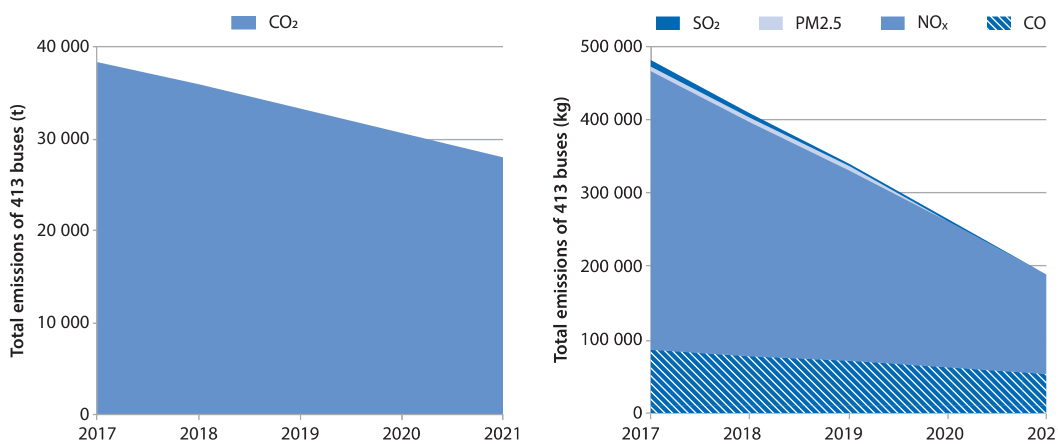
	Unit	Calculated using normative pollution factors	Calculated using real pollution factors
Total number of buses replaced	#	200	200
Total costs of buses replaced	KZT mln	6 421	6 421
• co-financed by the programme	KZT mln	3 079	3 079
• co-financed by private/municipal bus operators	KZT mln	3 342	3 342
Total CO_2 reduction	CO_2 t/year	5 013	12 434
Total CO reduction	kg/year	16 526	16 526
Total NO_x reduction	kg/year	117 612	117 612
Total PM reduction	kg/year	3 709	3 709
Total SO_2 reduction	kg/year	2 657	2 657

Source: OECD CPT Programme OPTIC Model.

As shown in Table 2.1, the CO_2 reduction is low due to the relatively high CO_2 emission factor from LPG (for details, see Annex B). On the other hand, the reductions in other pollutants are significant. The largest decrease can be achieved in NO_x emissions, which could be reduced by 117 612 kg/year. In terms of CO_2 emissions, Kostanay could contribute a reduction of 5 013 tCO_2 annually.

Figure 2.2 presents a projection of environmental outcomes in the city of Kostanay, including the second (scaling-up) phase. These investments can bring significant emission reductions.

Figure 2.2. **Projection for reducing CO_2 emissions and air pollutants in Kostanay, 2017-21**



Source: OECD CPT Programme OPTIC Model.

City of Shymkent

Shymkent is a large city in southern Kazakhstan[4] located on the route of a natural gas pipeline. It has already started to develop a modern public transport infrastructure, and 200 CNG buses are operating in the city, which already has CNG filling stations. Shymkent suffers from air pollution, making the reduction of emissions a very important objective for the city authorities.

Sixty-one very old (over 15 years old) diesel buses and 109 relatively old (10- to 15-year-old) models are running in the city.

Given the number of old buses in Shymkent, it is proposed that in the pilot phase, 100 buses be replaced with modern, CNG-engine models. The key input and output parameters of the pilot implementation in Shymkent are provided in Table 2.2.

In Shymkent, the total cost of the 100 replaced buses amounts to KZT 3 531 mln (USD 10.3 mln), of which the CPT Programme can support KZT 1 705 mln (USD 4.97 mln) and private bus operators can contribute KZT 1 826 mln (USD 5.32 mln).

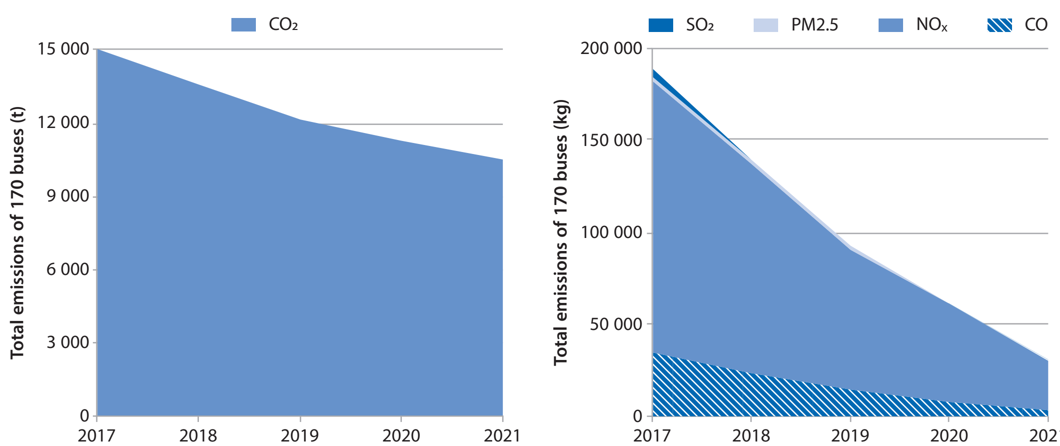
As shown in Table 2.2, the reductions of CO_2 and other pollutants are significant, should the programme be implemented in Shymkent. The expected NO_x reduction is 75 552 kg/year. In terms of CO_2 emissions, the reduction is estimated to be 2 827 tCO_2/year. Figure 2.3 shows a projection of environmental outcomes in Shymkent, including the second (scaling-up) phase.

Table 2.2. **Key input and output parameters of the pilot programme in Shymkent**

	Unit	Calculated using normative pollution factors	Calculated using real pollution factors
Total number of buses replaced	#	100	100
Total costs of buses replaced	KZT mln	3 531	3 531
• co-financed by the programme	KZT mln	1 705	1 705
• co-financed by private/municipal bus operators	KZT mln	1 826	1 826
Total CO_2 reduction	CO_2 t/year	2 827	6 427
Total CO reduction	kg/year	18 723	18 723
Total NO_x reduction	kg/year	72 552	72 552
Total PM reduction	kg/year	1 798	1 798
Total SO_2 reduction	kg/year	1 706	1 706

Source: OECD CPT Programme OPTIC Model.

Figure 2.3. **Projection for reducing CO_2 emissions and air pollutants in Shymkent, 2017-21**



Source: OECD CPT Programme OPTIC Model.

Summary of pilot programme implementation

Table 2.3 presents the summary input and output parameters for the pilot programme in the two cities. During the pilot phase, a total of 300 buses are expected to be replaced, of which 100 are CNG-fuelled and 200 LPG-fuelled. The total cost of the programme is estimated at KZT 9 952 mln (USD 29 mln), of which KZT 4 784 mln (USD 14 mln) will be covered by public finances and the rest by private or municipal bus operators. Total CO_2 emissions are expected to be reduced by 7 840 tCO_2/year (based on real pollution factors) and the greatest air pollution reduction can be achieved with NO_x emissions, which are expected to be cut by 190 164 kg/year.

Table 2.3. **Key input and output parameters of the programme's pilot phase**

	Unit	Normative pollution factors	Real pollution factors
Total number of buses replaced	#	300	300
• of which CNG	#	100	100
• of which LPG	#	200	200
Total cost of buses replaced	KZT mln	9 952	9 952
• co-financed by the programme	KZT mln	4 784	4 784
• co-financed by private/municipal bus operators	KZT mln	5 168	5 168
Total CO_2 reduction	CO_2 t/year	7 840	18 861
Total CO reduction	kg/year	35 250	35 250
Total NO_x reduction	kg/year	190 164	190 164
Total PM reduction	kg/year	5 507	5 507
Total SO_2 reduction	kg/year	4 363	4 363

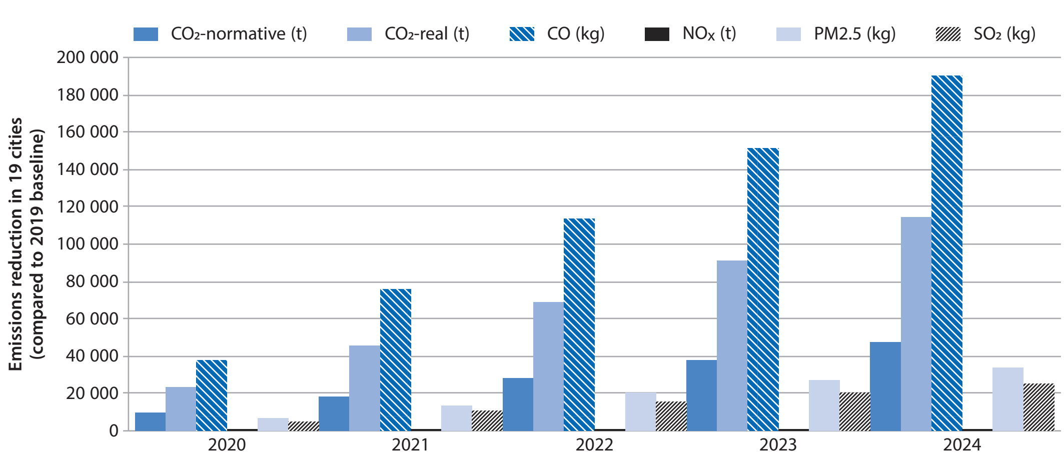
Source: OECD CPT Programme OPTIC Model.

Second phase

After the implementation of the pilot phase, an estimated 2 458 buses of more than 10 years old will remain in Kazakhstan. Of these 2 458 buses, 1 471 will still be more than 15 years old (also see Figure 2.9).[5] Since there will still be potential in the public transport sector for substantial environmental improvements, two scenarios for this second phase of the CPT Programme were costed using the OPTIC model developed for this study. The second phase of the programme is designed to cover all major urban centres in Kazakhstan (19 under Scenario 1, and 21 under Scenario 2) over a period of five years, and will aim to replace buses of more than 15 years old (Scenario 1) or buses more than 10 years old (Scenario 2). The reason that some cities (4 for Scenario 1 and 2 for Scenario 2) are not included is that these cities have no old buses.

Figure 2.4 presents the possible reduction of greenhouse gases and air pollution in 19 major cities of Kazakhstan.

Figure 2.4. **Amount of reduced GHG emissions in 19 cities of Kazakhstan, Scenario 1, 2020-24**



Source: OECD CPT Programme OPTIC Model.

Note: Kazakhstan has 23 regional cities, but 4 do not have old buses, as noted earlier, and will not be eligible for support under Scenario 1 of Phase 2 of the programme.

Table 2.4 summarises the key parameters of the assessed scenarios. While no sensitivity analysis was performed, as previously discussed, changes in the programme's cost-effectiveness might occur if prices used for the costing change.

Details of the two scenarios by each city for normative pollution factors are presented in Tables 2.5 and 2.6 below.

As Table 2.4 shows, under **Scenario 1 of Phase 2** of the programme, total programme investments are calculated to be KZT 61 526 mln (USD 179 mln), of which public financing amounts to KZT 30 399 mln (USD 89 mln). As Table 2.4 shows, under **Scenario 2 of Phase 2,** total investments will increase to KZT 94 581 mln (USD 276 mln), and public finances would contribute KZT 46 602 mln (USD 136 mln).

Table 2.4. **Key input and output parameters of the assessed programme scenarios**

		Scenario 1		Scenario 2	
	Unit	Normative pollution factors	Real pollution factors	Normative pollution factors	Real pollution factors
Total number of buses replaced	#	1 827		2 783	
• CNG	#	386		953	
• LPG (or modern diesel)	#	1 441		1 830	
Total number of cities where the programme is introduced	#	19		21	
• Number of cities where CNG buses are introduced	#	7		9	
• Number of cities where LPG or diesel buses are introduced	#	12		12	
Total costs of buses replaced	KZT mln	61 526		94 581	
• co-financed by the programme	KZT mln	30 399		46 602	
• co-financed by private/municipal bus operators	KZT mln	31 126		47 979	
• Costs of new CNG stations	KZT mln	1 632		2 176	
Total CO_2 reduction	CO_2 t/year	47 829	115 512	68 367	168 795
Total CO reduction	kg/year	193 140	193 140	319 610	319 610
Total NO_x reduction	kg/year	1 135 321	1 135 321	1 723 549	1 723 549
Total PM reduction	kg/year	33 827	33 827	50 169	50 169
Total SO_2 reduction	kg/year	25 881	25 881	39 729	39 729

Source: OECD CPT Programme OPTIC Model.

The main difference between these two scenarios is that Scenario 1 foresees that only buses of more than 15 years old will be financed through the programme, while under Scenario 2, the programme will also support buses more than 10 years old. It is worth noting that when the second phase of the programme begins, many of these 10-year buses will be more than 15 years old and more and may need to be replaced anyway. The costs of both scenarios also include the costs estimated for the pilot phase.

In terms of air pollution and CO_2 emission reductions, the most significant achievements are expected to be in NO_x emissions. Under Scenario 1, the NO_x emissions are estimated to decline by 1 135 321 kg/year, while under Scenario 2, the decline is greater and is estimated at 1 723 549 kg/year. The CO_2 emissions are estimated to decline by 47 829 tCO_2/year under Scenario 1, and 68 367 tCO_2/year under Scenario 2.

Table 2.5. **Key parameters of the assessed CPT Programme – Phase 2, Scenario 1, normative pollution factors**

	New buses			Investment costs	Subsidy	Emission reductions per year				
	Fuel									
City	Diesel	CNG	LPG	KZT mln	KZT mln	CO_2 (t)	CO (kg)	NO_x (kg)	PM2.5 (kg)	SO_2 (kg)
Kokshetau	0	0	55	1 766	847	1 379	4 545	32 343	1 020	731
Aktobe	0	6	0	756	646	186	1 161	4 518	111	106
Taldykorgan	0	0	0	0	0	0	0	0	0	0
Astana	0	0	117	3 756	1 801	2 933	9 668	68 803	2 170	1 554
Almaty	0	163	0	5 756	2 780	5 062	31 542	122 749	3 023	2 867
Atyrau	0	0	0	0	0	0	0	0	0	0
Semey	0	0	48	1 541	739	1 203	3 966	28 227	890	638
Ust-Kamenogorsk	0	0	219	7 031	3 371	5 489	18 096	128 785	4 062	2 910
Taraz	0	14	0	1 038	783	435	2 709	10 543	260	246
Uralsk	0	56	0	1 978	955	1 739	10 837	42 171	1 039	985
Karaganda	0	0	297	9 535	4 572	7 444	24 542	174 654	5 508	3 946
Temyrtau	0	0	10	321	154	251	826	5 881	185	133
Zhezkazgan	0	0	19	610	293	476	1 570	11 173	352	252
Kostanay	0	0	413	13 259	6 358	10 352	34 127	242 869	7 659	5 487
Rudniy	0	0	146	4 687	2 248	3 660	12 064	85 857	2 708	1 940
Kyzylorda	0	46	0	1 624	785	1 429	8 902	34 641	853	809
Pavlodar	0	0	78	2 504	1 201	1 955	6 445	45 869	1 447	1 036
Ekybastuz	0	0	24	770	369	602	1 983	14 113	445	319
Aktau	0	0	0	0	0	0	0	0	0	0
Zhanaozen	0	1	0	579	561	31	194	753	19	18
Petropavlovsk	0	0	15	482	231	376	1 239	8 821	278	199
Shymkent	0	100	0	3 531	1 705	2 827	18 723	72 552	1 798	1 706
Turkestan	0	0	0	0	0	0	0	0	0	0
TOTAL	***0***	***386***	***1 441***	***61 526***	***30 399***	***47 829***	***193 140***	***1 135 321***	***33 827***	***25 881***

Source: OECD CPT Programme OPTIC Model.

Similar calculations under Scenario 2 are shown in Table 2.6 below. The cities of Aktau and Turkestan are not eligible for support from the programme. The level of investments, subsidies or related emission reductions for these cities is shown as zero, since neither city has buses of more than 10 years old.

Table 2.6. **Key parameters of the assessed CPT Programme – Phase 2, Scenario 2, normative pollution factors**

	New buses			Investment costs	Subsidy	Emission reduction per year				
	Fuel									
City	Diesel	CNG	LPG	KZT mln	KZT mln	CO_2 (t)	CO (kg)	NO_x (kg)	PM2.5 (kg)	SO_2 (kg)
Kokshetau	0	0	127	4 077	1 955	2 670	9 335	69 599	2 251	1 590
Aktobe	0	75	0	3 193	1 823	1 837	13 402	51 607	1 291	1 226
Taldykorgan	0	0	9	289	139	161	599	4 657	154	107
Astana	0	0	227	7 288	3 495	4 905	16 986	125 721	4 050	2 867
Almaty	0	**368**	**0**	12 996	6 276	9 966	67 911	262 649	6 527	6 195
Atyrau	0	35	0	1 780	1 141	837	6 209	23 885	598	568
Semey	0	0	82	2 633	1 262	1 813	6 228	45 820	1 471	1 043
Ust-Kamenogorsk	0	0	276	8 861	4 249	6 511	21 889	158 279	5 036	3 590
Taraz	0	77	0	3 263	1 857	1 942	13 886	53 537	1 337	1 269
Uralsk	0	110	0	3 885	1 876	3 031	20 417	79 023	1 962	1 862
Karaganda	0	0	305	9 792	4 695	7 588	25 074	178 793	5 645	4 041
Temyrtau	0	0	18	578	277	394	1 359	10 020	322	228
Zhezkazgan	0	0	42	1 348	647	889	3 100	23 074	746	527
Kostanay	0	0	413	13 259	6 358	10 352	34 127	242 869	7 659	5 487
Rudniy	0	0	150	4 816	2 309	3 731	12 330	87 927	2 776	1 987
Kyzylorda	0	114	0	4 026	1 944	3 055	20 965	81 047	2 016	1 913
Pavlodar	0	0	86	2 761	1 324	2 099	6 978	50 008	1 583	1 132
Ekybastuz	0	0	28	899	431	673	2 249	16 183	513	367
Aktau	0	0	0	0	0	0	0	0	0	0
Zhanaozen	0	4	0	685	612	103	726	2 800	70	66
Petropavlovsk	0	0	67	2 151	1 031	1 308	4 699	35 728	1 167	820
Shymkent	0	170	0	6 003	2 899	4 502	31 142	120 323	2 995	2 843
Turkestan	0	0	0	0	0	0	0	0	0	0
TOTAL	***0***	**953**	**1 830**	**94 581**	**46 602**	**68 367**	**319 610**	**1 723 549**	**50 169**	**39 729**

Source: OECD CPT Programme OPTIC Model.

Details of the two scenarios by each city for the **real pollution factors** are presented in Tables 2.7 and 2.8 below.

Table 2.7. **Key parameters of the assessed CPT Programme – Phase 2, Scenario 1, real pollution factors**

	New buses			Investment costs	Subsidy	Emission reduction per year				
	Fuel									
City	Diesel	CNG	LPG	KZT mln	KZT mln	CO_2 (t)	CO (kg)	NO_x (kg)	PM2.5 (kg)	SO_2 (kg)
Kokshetau city	0	0	55	1 766	847	3 419	4 545	32 343	1 020	731
Aktobe	0	6	0	756	646	409	1 161	4 518	111	106
Taldykorgan	0	0	0	0	0	0	0	0	0	0
Astana	0	0	117	3 756	1 801	7 274	9 668	68 803	2 170	1 554
Almaty	0	163	0	5 756	2 780	11 111	31 542	122 749	3 023	2 867
Atyrau	0	0	0	0	0	0	0	0	0	0
Semey	0	0	48	1 541	739	2 984	3 966	28 227	890	638
Ust-Kamenogorsk	0	0	219	7 031	3 371	13 616	18 096	128 785	4 062	2 910
Taraz	0	14	0	1 038	783	954	2 709	10 543	260	246
Uralsk	0	56	0	1 978	955	3 817	10 837	42 171	1 039	985
Karaganda	0	0	297	9 535	4 572	18 465	24 542	174 654	5 508	3 946
Temyrtau	0	0	10	321	154	622	826	5 881	185	133
Zhezkazgan	0	0	19	610	293	1 181	1 570	11 173	352	252
Kostanay	**0**	**0**	**413**	**13 259**	**6 358**	**25 677**	**34 127**	**242 869**	**7 659**	**5 487**
Rudniy	0	0	146	4 687	2 248	9 077	12 064	85 857	2 708	1 940
Kyzylorda	0	46	0	1 624	785	3 136	8 902	34 641	853	809
Pavlodar	0	0	78	2 504	1 201	4 849	6 445	45 869	1 447	1 036
Ekybastuz	0	0	24	770	369	1 492	1 983	14 113	445	319
Aktau	0	0	0	0	0	0	0	0	0	0
Zhanaozen	0	1	0	579	561	68	194	753	19	18
Petropavlovsk	0	0	15	482	231	933	1 239	8 821	278	199
Shymkent	**0**	**100**	**0**	**3 531**	**1 705**	**6 427**	**18 723**	**72 552**	**1 798**	**1 706**
Turkestan	0	0	0	0	0	0	0	0	0	0
TOTAL	***0***	**386**	**1 441**	**61 526**	**30 399**	**115 512**	**193 140**	**1 135 321**	**33 827**	**25 881**

Source: OECD CPT Programme OPTIC Model.

Table 2.8. **Key parameters of the assessed CPT Programme – Phase 2, Scenario 2, real pollution factors**

	New buses			Investment costs	Subsidy	Emission reduction per year				
	Fuel									
City	Diesel	CNG	LPG	KZT mln	KZT mln	CO_2 (t)	CO (kg)	NO_x (kg)	PM2.5 (kg)	SO_2 (kg)
Kokshetau city	0	0	127	4 077	1 955	7 177	9 335	69 599	2 251	1 590
Aktobe	0	75	0	3 193	1 823	4 423	13 402	51 607	1 291	1 226
Taldykorgan	0	0	9	289	139	470	599	4 657	154	107
Astana	0	0	227	7 288	3 495	13 014	16 986	125 721	4 050	2 867
Almaty	0	368	0	12 996	6 276	23 036	67 911	262 649	6 527	6 195
Atyrau	0	35	0	1 780	1 141	2 036	6 209	23 885	598	568
Semey	0	0	82	2 633	1 262	4 758	6 228	45 820	1 471	1 043
Ust-Kamenogorsk	0	0	276	8 861	4 249	16 590	21 889	158 279	5 036	3 590
Taraz	0	77	0	3 263	1 857	4 619	13 886	53 537	1 337	1 269
Uralsk	0	110	0	3 885	1 876	6 959	20 417	79 023	1 962	1 862
Karaganda	0	0	305	9 792	4 695	18 883	25 074	178 793	5 645	4 041
Temyrtau	0	0	18	578	277	1 039	1 359	10 020	322	228
Zhezkazgan	0	0	42	1 348	647	2 381	3 100	23 074	746	527
Kostanay	**0**	**0**	**413**	**13 259**	**6 358**	**25 677**	**34 127**	**242 869**	**7 659**	**5 487**
Rudniy	0	0	150	4 816	2 309	9 286	12 330	87 927	2 776	1 987
Kyzylorda	0	114	0	4 026	1 944	7 091	20 965	81 047	2 016	1 913
Pavlodar	0	0	86	2 761	1 324	5 267	6 978	50 008	1 583	1 132
Ekybastuz	0	0	28	899	431	1 701	2 249	16 183	513	367
Aktau	0	0	0	0	0	0	0	0	0	0
Zhanaozen	0	4	0	685	612	243	726	2 800	70	66
Petropavlovsk	0	0	67	2 151	1 031	3 646	4 699	35 728	1 167	820
Shymkent	**0**	**170**	**0**	**6 003**	**2 899**	**10 499**	**31 142**	**120 323**	**2 995**	**2 843**
Turkestan	0	0	0	0	0	0	0	0	0	0
TOTAL	***0***	**953**	**1 830**	**94 581**	**46 602**	**168 795**	**319 610**	**1 723 549**	**50 169**	**39 729**

Source: OECD CPT Programme OPTIC Model.

In terms of investment, the **first scenario** assumes that about KZT 10 bln (USD 29.2 mln) annually will be disbursed from both public and private sources.[6] The **second scenario** assumes that the CPT Programme will require expenditure of KZT 16 bln (USD 46.7 mln) annually.

Table 2.9 below summarises the size, results and associated costs of the programme on the basis that the programme is implemented directly by a government-established implementation unit. The annual amounts are estimated by dividing the public co-financing required in a given scenario (excluding the pilot phase) by the five years of implementation in the second phase.

Table 2.9. **Summary of programme costs, KZT million**

	Investment costs	Public co-financing							
		Total	Year						
			1	2	3	4	5	6	7
Scenario 1									
Preparation costs (including fundraising)	10.5	10.5	10.5						
Pilot phase	*9 952*	*4 784*		*4 784*					
Implementation unit (operating costs)	75	75			15	15	15	15	15
Programme promotion	30	30			10	10	5	5	
Second phase	*51 573*	*25 615*			*5 123*	*5 123*	*5 123*	*5 123*	*5 123*
Total Scenario 1	**61 641**	**30 514**	**11**	**4 784**	**5 148**	**5 148**	**5 143**	**5 143**	**5 138**
Scenario 2									
Preparation costs (including fundraising)	10.5	10.5	10.5						
Pilot phase	*9 952*	*4 784*		*4 784*					
Implementation unit (operating costs)	75	75			15	15	15	15	15
Programme promotion	30	30			10	10	10	10	
Second phase	*84 629*	*41 818*			*8 364*	*8 364*	*8 364*	*8 364*	*8 364*
Total Scenario 2	**94 697**	**46 717**	**11**	**4 784**	**8 389**	**8 389**	**8 389**	**8 389**	**8 379**

Source: OECD CPT Programme OPTIC Model.

The programme preparation costs (including fundraising) are estimated on the assumption that one person will be working during the first year and that this will cost KZT 10.5 mln (one person, KZT 250 000 per month gross × 12 months + KZT 7 500 000 external costs). The costs of maintaining the implementation unit are estimated on the assumption that 5 people will be hired to work on the programme (five people, KZT 250 000 per month gross per person × 12 months).

Table 2.10 mirrors Table 2.9, but all costs are recalculated in US dollars.

Table 2.10. **Summary of programme costs, USD million**

	Investment costs	Public co-financing							
		Total	Year						
			1	2	3	4	5	6	7
Scenario 1									
Preparation costs (including fundraising)	0.03	0.03	0.03						
Pilot phase	*29*	*14*		*14*					
Implementing unit (operating costs)	0.22	0.22	0.00		0.04	0.04	0.04	0.04	0.04
Programme promotion	0.09	0.09			0.03	0.03	0.01	0.01	
Second phase	*150*	*75*			*15*	*15*	*15*	*15*	*15*
Total Scenario 1	**180**	**89**	**0**	**14**	**15**	**15**	**15**	**15**	**15**
Scenario 2									
Preparation costs (including fundraising)	0.03	0.03	0.03						
Pilot phase	*29*	*14*		*14*					
Implementation unit (operating costs)	0.22	0.22	0.00		0.04	0.04	0.04	0.04	0.04
Programme promotion	0.09	0.09			0.03	0.03	0.03	0.03	
Second phase	*247*	*122*			*24*	*24*	*24*	*24*	*24*
Total Scenario 2	**276**	**136**	**0**	**14**	**24**	**24**	**24**	**24**	**24**

Source: OECD CPT Programme OPTIC Model.

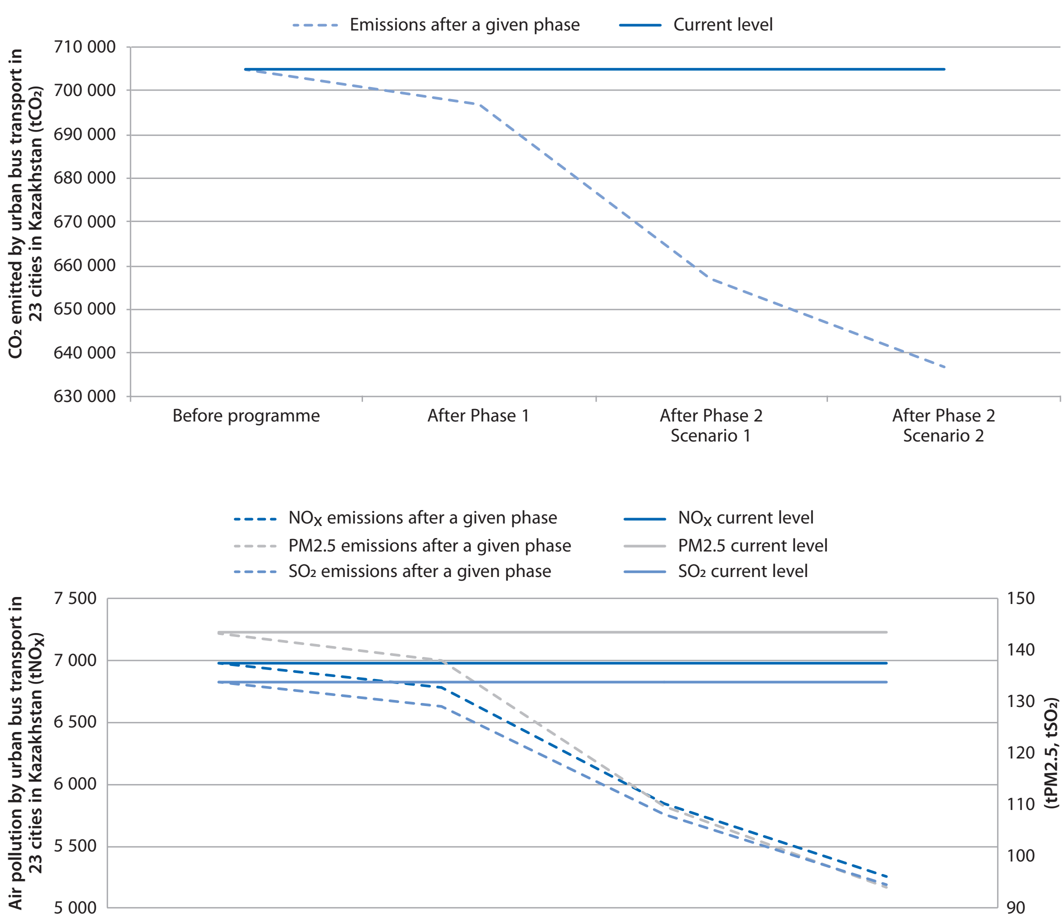
The programme preparation costs and the costs of maintaining an implementation unit are calculated in the same way as the costs in KZT.

The estimates of domestic fuel costs were calculated based on the costs identified on the domestic market, as described in the Market Study in Chapter 5:

- CNG: KZT 35.315 mln (USD 103 000);
- LPG: KZT 32.104 mln (USD 94 000);
- Diesel: KZT 30.708 mln (USD 90 000).

Figure 2.5 shows possible CO_2 and NO_x emission reductions throughout the various stages of programme implementation, compared to current levels of emissions. It is with these two pollutants that the greatest emission reductions can be expected. Obviously, significant emission reductions start accumulating with the implementation of Phase 2 of the programme. By the end of Scenario 2, CO_2 emissions are estimated to decrease by about 70 000 tonnes/year, while in the case of NO_x emissions, this reduction is estimated to amount to about 1.7 mln kg/year. These reductions are estimated using the normative pollution factors approach.

Figure 2.5. **Potential reduction of CO_2 and air pollutants as a result of the programme**



Source: OECD CPT Programme OPTIC Model.

Financing strategy and optimal co-financing level

The CPT Programme can be financed by a mix of public funds (state and/or international) and private funds. The programme can be financed by the state budget within the medium-term expenditure framework (MTEF) process. Thus, the types of financial support can be provided in the form of:

- grant co-funding; and
- equity co-financing.

Grants are the simplest and most straightforward form of public support and the easiest for a public financier to manage. Grants are also the most attractive source of financing from the perspective of an applicant. Grants are transparent and do not require repayment by recipients, although other conditions may be attached to the grant (e.g. repayment if the recipient does not apply the grant for the intended/contracted purposes if the project fails to reach the initial objectives).

The major drawback of grants is the "moral hazard" sometimes associated with "free money". Because grants do not provide sufficient incentives to beneficiaries to save resources, projects that receive grants require special monitoring of the results achieved.

In providing support to equity investments, the public financier buys shares in the enterprise. These shares can then be sold later on at a profit. A challenge related to this instrument is the choice of the time when the public financier decides to sell its shares. The government of Kazakhstan already has experience with equity investments.

Private funds will come from private operators' own resources including savings, current revenues/profits, capital that can be raised on capital markets, and commercial loans. Passenger fares are the main source of revenue for bus operators. Given the social nature of public bus transport setting the optimal level of passenger fares is an important part of this debate.

Passenger fares

Fares are used to finance capital and operating costs of public transport services. In most countries, public transport systems generate a deficit, which means that receipts from tickets do not cover all costs of these services and services are subsidised. For this reason, public transport services are usually provided by public (municipal) entities.

In the case of Kazakhstan, almost all public service operators, with the exception of four municipal operators, are private. Private operators provide business for profit, and passenger fares need to cover capital and operating costs. On the other hand, fares for public transport are relatively low in Kazakhstan and a number of discounts or exemptions are offered. Consequently, the quality of service provided by private operators is rather low. This means that operators provide services based on used, very old buses to minimise capital costs (and depreciation).

An increase in fares could theoretically be used to co-finance the CPT Programme. Conducting a sensitivity analysis on how many new buses could be bought for an increase in fares by an increment of KZT 10 (USD 0.03) could be very informative. Such an analysis is not provided in this document because to achieve the desired environmental effects, it is important that private transport should not substitute for public transport. Fare increases lead to an exposure-response relationship with strong negative price elasticity. Further, such a sensitivity analysis depends on local circumstances, including route length and number of passengers. Current fares in the pilot cities are detailed in the Market Study.

Share of public and private funds in co-financing of the CPT Programme

To make optimal use of the public funds (the optimal subsidy level) that can be applied in co-financing the costs of the purchase of the new, clean buses, it is estimated that the public funds should not exceed the rates provided in Table 2.11. This co-financing implies 48% of public support for the purchase of buses powered by CNG or LPG and 81% for buses with engines fuelled by modern Euro 5 or 6 diesel. The construction of CNG filling stations can be supported at 100% when the number of CNG buses is lower than 100. Any side investments related to improvements in the urban transport system are anticipated to be provided by the cities themselves.

Table 2.11. **Summary of public support for the programme**

Programme pipeline	Public co-financing	Private co-financing
Buses with engines fuelled by CNG	48%	52%
Buses with engines fuelled by LPG	48%	52%
Buses with engines fuelled by modern diesel (Euro 5 and Euro 6)	81%	19%
CNG stations	100% when the number of CNG buses is lower than 100	100% when the number of CNG buses exceeds 100
LPG stations	0%	Provided by the private sector
Side investments	Provided by cities	0%

Source: OECD CPT Programme OPTIC Model.

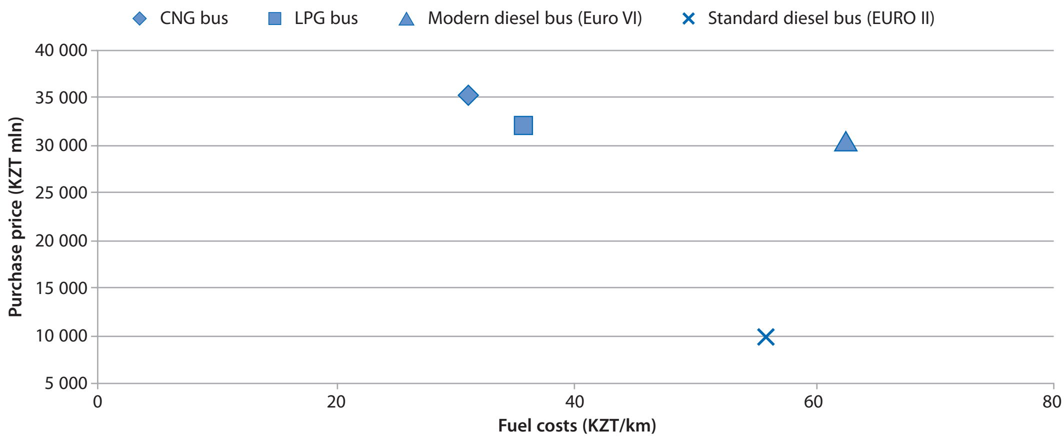
The contribution of the public budget is calculated in terms of the optimal level of public support, defined as the amount of subsidy required such that the net present value (NPV) of the proposed investment is equal to zero and measured as a percentage of the total project investment cost (for further discussion, see Annex B, "Determining the subsidy level").

The calculation of the subsidy level takes into account the marginal costs of new, clean buses (compared to old bus models) and the current unit price of fuel. The OPTIC model checks that bus replacement does not lead to financial losses for the public transport operator. Thus, a social discount rate of 5% is used to determine the NPV of a typical project (e.g. bus replacement for CNG, LPG or Euro VI diesel bus).

Two issues need to be raised regarding the calculation of this optimal subsidy level. First, it should be noted that if a public transport operator has already modernised his fleet, it is hardly likely that he will need to replace buses in the near future (as would be the case with old buses, in particular those more than 15 years old). Thus, only the price difference between modern clean buses and traditional buses is taken into account when calculating the subsidy level.[7] Second, some fuels will be cheaper than diesel. For example, CNG and LPG are cheaper than diesel even taking into account increased consumption. Therefore, savings in fuel costs for public transport operators are taken into account when calculating the subsidy level.

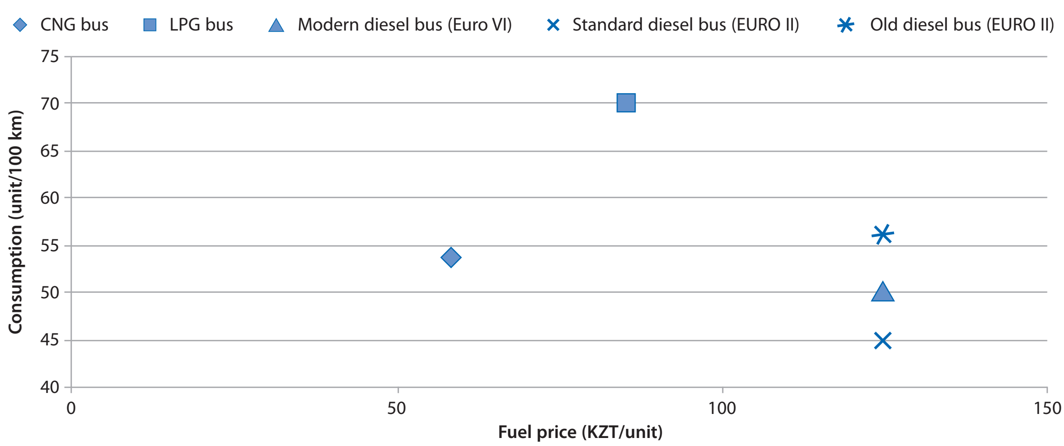
Figures 2.6 and 2.7 show the relationships of some economic variables (purchase price and fuel cost) for different types of buses that are important to consider in making financial decisions. As seen in Figure 2.6, while the purchase price (or the initial investment) of clean fuel-powered buses is significantly higher than a traditional diesel engine bus, the costs of fuel over the useful lifetime of the bus are much lower, which allows for additional savings.

Figure 2.6. **Relationship between purchase price and fuel costs for diesel and alternatively powered buses**



Source: OECD CPT Programme OPTIC Model.

Figure 2.7. **Relationship between consumption and fuel price for diesel and alternatively powered buses**



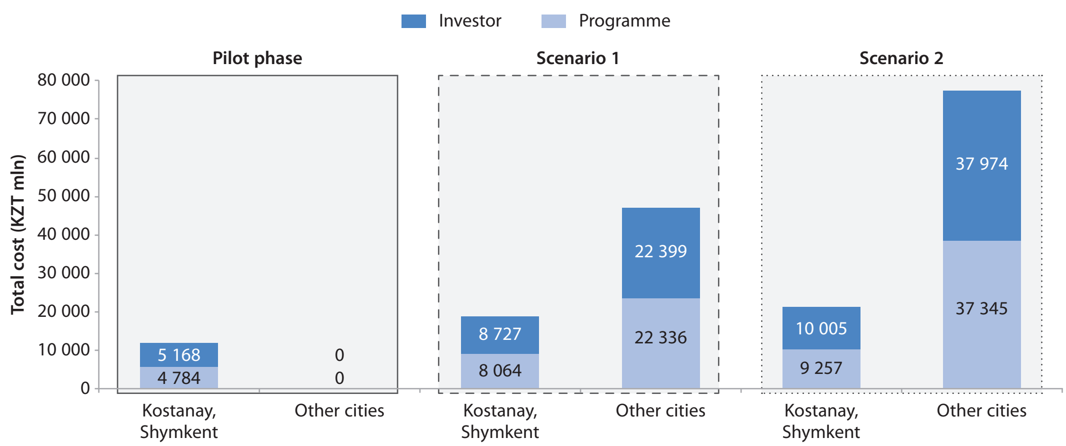
Source: OECD CPT Programme OPTIC Model.

Similarly, Figure 2.7 shows that CNG is cheaper than old diesel and its consumption per 1 000 kilometres is less than that of old diesel (for exact fuel consumption values, see Table B.1).

It is essential that market developments (e.g. changes in bus and fuel prices, development of the market for new engines, and availability of other financing sources) and the way they interact with the CPT Programme design be regularly monitored. Such market changes need to be reflected in the programme, and the subsidy level provided by the state adjusted accordingly. A section on "Programme costing for Phase 1 (pilot phase) and Phase 2 (scaling-up phase)" in Annex B provides an indicative calculation of the optimal subsidy level based on current (December 2016) bus and fuel prices. These, however, are offered more as an illustration of how the subsidy level needs to be calculated, rather than as absolute values. The model provides an opportunity to adjust and optimise the programme assumptions and its effects by changing the basic data as appropriate.

Figure 2.8 presents an overall comparison of the programme costs for private and public sector financiers in the pilot phase and in the two scenarios of the scaling-up phase.

Figure 2.8. **Share of public and private costs in financing the two phases of the programme**



Source: OECD CPT Programme OPTIC Model.

Social impact of programme implementation

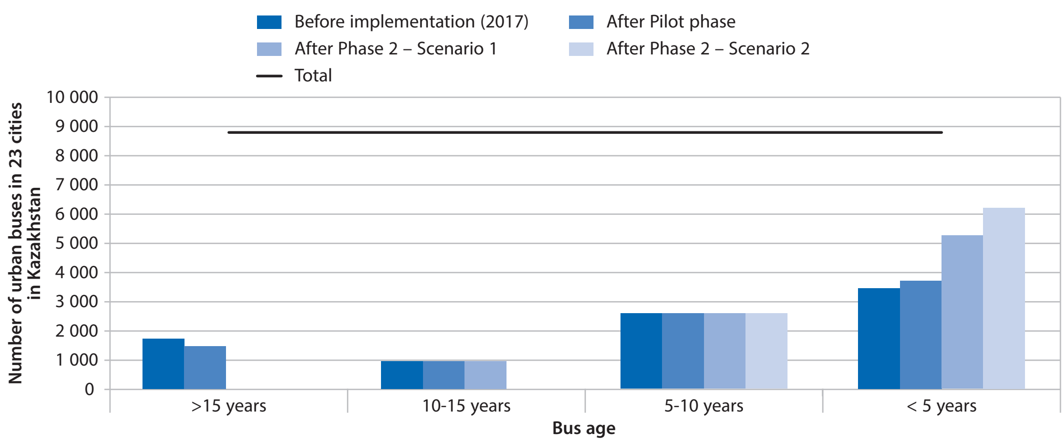
Implementing the CPT Programme will have various social effects (benefits related to the impact on human health are not discussed here). The major and direct impact will be the improvement of passengers' comfort. The replacement of old (outdated) diesel buses with modern ones will ensure both better reliability (continuity) of the service as well as a number of on-board conveniences such as: heating and air conditioning, passenger information, better accessibility for elder and disabled people. It is suggested that new buses should be "low-floor" buses, with a bus deck accessible from the sidewalk, with only one step and a small height difference. Figure 2.9 presents a projection for changing the age structure of the bus fleet at the country level, based on programme implementation.

Implementing the programme will also require an increase in employment, given the increased demand for bus production. Bus production in Kazakhstan is insignificant at present; for example, Daewoo Bus Kazakhstan currently produces a maximum of 150 buses per year.

Implementation of the programme (and especially its second phase) along with other programmes (like the European Bank for Reconstruction and Development's programme for urban transport in the city of Almaty) can significantly increase the need for domestically produced buses. The implementation of Scenario 2 of Phase 2 of the programme may require additional production of more than 500 modern buses per year. The assumption is that under Scenario 2, there will be a need for 2 783 buses, which implies 556.6 per year (5 years of implementation). Thus, we assume that bus production will increase by about 500 annually.

According to information provided to the OECD by Daewoo Bus Kazakhstan,[8] the additional production of 500 buses will require 130 additional jobs, excluding management costs. The reason for this quite modest job increase is the rather simple production process, which would require more assembly work than domestic manufacturing. For example, Solaris Bus & Coach currently employs 2 300 people and an additional 500 employers in its sale and maintenance network, while producing 1 200 buses annually. In addition, automobile industries employ 5 to 8 times more people indirectly, through co-operative vendor networks.

Figure 2.9. **Altering the age structure of the bus fleet in Kazakhstan**



Source: OECD CPT Programme OPTIC Model.

By creating demand and conditions for bus production for an additional 500 buses per year, the CPT Programme may stimulate economic development and the creation of jobs. The minimum outcome of the programme will be about 130 jobs for simple production/ assembling. If Kazakhstan decides that buses are to be fully produced domestically, direct employment will increase by 600 to 800 new posts. If most of the vendor network for the bus producer is to be domestic, the total number of additional jobs could be in the thousands, including employment in small and medium-sized enterprises (SME).

Types of eligible projects and eligible project costs

The types of eligible projects and respective eligible project costs to be supported by the CPT Programme are discussed below. Eligible costs are strictly related to the project investment expenditure needed to achieve the project's stated objectives. General investment costs not attributable to the achievement of project objectives are excluded.

Eligible projects include investments in the replacement of buses aimed at reducing air pollution from public transport in urban centres and improving service quality.

The suggested costs eligible to be funded by the programme include:

- Costs of studies (feasibility studies and business plans) associated with bus replacement that do not exceed KZT 3 mln (USD 9 000) for a single city; this cost is 100% financed by the programme.
- Costs of constructing a CNG filling station associated with the replacement of old buses with CNG-powered models; public co-financing, however, is provided only when the number of associated CNG-powered buses is lower than 100.
- Costs of replacement of buses more than 10 years old that provide public transport services in the urban centres of the following cities in Kazakhstan: Kokshetau, Aktobe, Taldykorgan, Astana, Almaty, Atyrau, Semey, Ust-Kamenogorsk, Taraz, Uralsk, Karaganda, Temyrtau, Zhezkazgan, Kostanay, Rudniy, Kyzylorda,

Pavlodar, Ekybastuz, Aktau, Zhanaozen, Petropavlovsk, Shymkent, Turkestan. The new buses must meet the following criteria:

- the bus must be at least 10 metres long (minibuses are excluded);
- the bus engine must be powered by diesel Euro (5, 6), CNG or LPG;
- in the case of diesel engines, the proposed models must be certified for technical classes Euro V or Euro VI equivalent for emission standards, low sulphur diesel must be available in the city, and the beneficiary must ensure that the environmental equipment installed to reduce emissions is not dismantled.

- Other costs, such as assembling a maintenance workshop for new buses, are eligible only when directly connected to the costs listed above and provided they do not exceed 10% of the total costs of the bus replacement.
- Costs of additional investments that improve public transport services in the cities – such as separated bus lanes, ticketing systems and smart traffic lights – are eligible but must be fully financed by the respective city.

The land acquisition and other costs not listed are not eligible for support under the programme.

Types of eligible beneficiaries

The following types of beneficiaries are eligible to receive support from the CPT Programme:

- private public transport operators that currently provide services in eligible urban centres;
- municipal public transport operators that already provide services in eligible urban centres;
- city administration – for the preparation of necessary studies;
- natural gas providers for CNG filling stations.

Project eligibility criteria

The types of eligible projects, eligible costs and eligible beneficiaries (project owners) are part of the eligibility criteria for screening individual projects that apply for public support. The purpose of eligibility criteria is to conduct an initial and simple assessment of those projects that appear to address all crucial objectives related to the CPT Programme and that can potentially qualify for financing. Eligibility criteria should be simple, straightforward and clearly specified.

This section provides the list and description of the minimum eligibility (threshold/knock-out) criteria. Knock-out criteria refer to those conditions that a project must meet; failure to meet even one of these criteria at this stage results in rejection of the project. Projects that pass the eligibility assessment but are determined to lack sufficient information are returned to the applicant with a request for clarification (for example, to clarify the ownership structure). The proposed eligibility evaluation form is presented in Annex D to this report.

The following eligibility criteria could be used in screening projects:

1. Criteria related to the types of location of the project: limited to urban centres.
2. Criteria related to the types of eligible projects:
   - 2.1. The project type should be identified in the list of eligible projects.
   - 2.2. All proposed costs of the project should be possible to identify in the list of eligible costs.
   - 2.3. Replaced buses are more than 10 years old.
   - 2.4. Investment in a CNG filling station should be accompanied by replacement of old buses with new CNG buses.
3. Criteria related to the types of eligible beneficiaries: the type of beneficiary should be on the list of eligible beneficiaries.
4. Other eligibility criteria: existing city plans for additional investments to improve the city's urban public transport system.

Project appraisal criteria

Experience shows that a well-designed appraisal system is the foundation for selecting the most cost-effective investment projects that can be financed with public resources from the programme. The appraisal system and selection procedures should be tailored to the size and complexity of different project types. For investment projects, as is the case here, a two-stage appraisal process is usually recommended. The first stage involves screening projects against eligibility criteria, and the second, appraisal and ranking of eligible projects and selection of projects for financing.

All projects that pass through the eligibility screening (pre-appraisal) are examined (appraised) and ranked (based on an awarded score) according to a set of appraisal and ranking criteria. Projects that have obtained the highest scores provide the best contribution to achieving the CPT Programme objectives. Depending on the funds available for the programme in a given time period, the ranked projects – beginning with the highest scores – are selected for co-financing and further implemented. The proposed evaluation form is presented in Annex E to this report.

The following appraisal criteria are proposed to evaluate projects in this pipeline:

1. Project preparation
   a. prepared business plan for project implementation in the city;
2. Project location:
   a. buses that will be replaced are in polluted cities (list of eligible cities);
   b. buses that will be replaced are used only in the centre of the eligible city;
   c. buses that will be replaced are used in the city centre and on the outskirts/suburbs of the eligible city;
   d. buses that will be replaced are used in the city and connecting rural area outside the eligible city.

3. Project type:
   a. CNG buses are assigned the highest priority;
   b. LPG buses;
   c. modern diesel buses are assigned the lowest priority.[9]
4. Project size:
   a. replacement of more than 200 buses;
   b. replacement of between 100 and 200 buses;
   c. replacement of fewer than 100 buses.[10]
5. Proposed system of improvements of the urban public transport system in the city:
   a. length of new bus lanes;
   b. number of traffic lights with priority for public transport;
   c. number of bus stops newly equipped with online information for passengers;
   d. number of new bus stops.
6. Environmental efficiency: Cost per reduction of a unit of particulate matter (PM2.5).

Conclusions for the CPT Programme

The following project pipelines that could be supported through a future investment programme have been identified with the project partners. These include:

- Replacement of the old bus fleet in urban centres with modern buses equipped with engines that run on:
  - compressed natural gas (CNG);
  - liquefied petroleum gas (LPG);
  - diesel, but possibly the use/import of Euro 5/6 fuel.

  As the bus fleet in Kazakhstan is ageing, the proposed pipelines are intended to support the purchase of new buses and not just the modernisation of engines.
- Other investments to improve the transport system in urban centres (e.g. the creation of bus lanes and smart traffic control).

Clearly specifying the eligibility criteria (in terms of the project types, beneficiaries and project costs that will be supported by the programme) and setting robust project appraisal criteria will make the implementation of the programme more transparent and efficient.

Conclusions for the CPT Programme

Using the OPTIC model, the programme costs and results (reduction of emissions of air pollutants and GHG) for the pilot phase were calculated and two scenarios for the second phase proposed. Scenario 1 takes into account the replacement of all buses (excluding minibuses) that are now more than 15 years old. This would involve replacing 1 827 outdated buses with modern models powered with CNG, LPG or possibly modern diesel engines. Scenario 2 takes into account the replacement of all buses (excluding minibuses) that are now more than 10 years old. This would involve the replacement of 2 783 buses by modern vehicles powered with clean fuels.

It was further agreed that the cities of Shymkent and Kostanay would serve as pilot cities for CNG and LPG/diesel, respectively.

Applying a robust methodology – to estimate the costs of the investment programme, set the optimal level of subsidy and forecast the expected environmental benefits – can make the programme more credible for both national and international public financiers.

The aim of project appraisal is to assess a project on the basis of clearly specified and rigorous criteria. These allow programme managers to compare, rank and select the most cost-effective projects for financing. When these criteria are applied uniformly across all (similar) projects, they can also help reduce the discretion of the management in selecting individual projects for financing.

Notes

1. As specified in the Intended Nationally Determined Contribution prepared by the Government of Kazakhstan for the COP21 in Paris in 2015 (GoK, 2015).
2. As used here, a "project pipeline" is a set of projects in a given sector. These projects have been conceived and developed to achieve the objectives of the investment programme. Thus, the project pipeline is a repeatable procedure according to which priority projects are identified for their compliance with the investment programme objectives.
3. Several petrol stations offering better fuel from the Russian Federation already operate in Kostanay.
4. While the city's population is under 1 mln, the population of the agglomeration is 1.4 mln.
5. See Chapter 5: Market Analysis. Currently, Kazakhstan has 2 758 buses of more than 10 years old.
6. Calculated as (KZT 60 bln minus KZT 10 bln in the pilot phase) divided by 5 years.
7. Given that most public transport operators would rather buy used, but relatively new buses, the price of a used bus served as the basis for the calculation.
8. We are grateful to the management of Daewoo Bus Kazakhstan for sharing this information with the project team.
9. In the future, diesel buses may have higher priority, if and when Kazakhstan implements clean fuel standards and strict air pollution limits for diesel engines.
10. The appraisal system should award fewer points to projects involving CNG buses when CNG filling stations are commercially not profitable (less than 100 CNG buses).

References

Franco, V. et al. (2014), Real-World Exhaust Emissions from Modern Diesel Cars. A Meta-Analysis of Pems Emissions Data from EU (Euro 6) and US (Tier 2 Bin 5/Ulev II) Diesel Passenger Cars, International Council on Clean Transportation, Berlin, www.theicct.org/sites/default/files/publications/ICCT_PEMS-study_diesel-cars_20141010.pdf.

GoK (2015), *Intended Nationally Determined Contribution – Submission of the Republic of Kazakhstan*, Government of the Republic of Kazakhstan, Astana, www4.unfccc.int/submissions/INDC/Published%20Documents/Kazakhstan/1/INDC%20Kz_eng.pdf.

Chapter 3

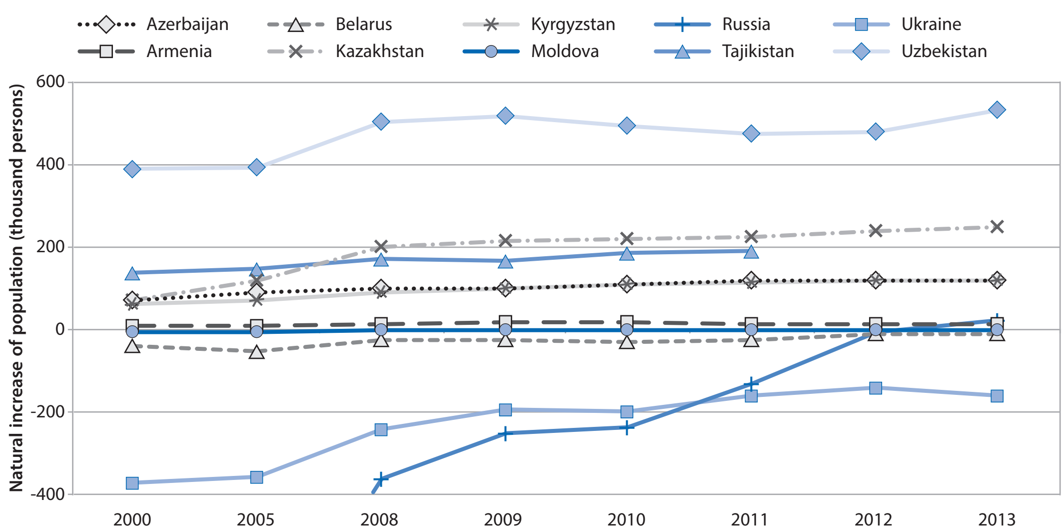
Review of macro-economic and environmental conditions

This chapter briefly describes the main demographic, macro-economic and environmental issues in Kazakhstan with respect to the transport sector. It also presents an overview of the urban public transport system in the country as well as the level of greenhouse gas emissions and air pollution in the main urban centres. Finally, the major health risks associated with the main air pollutants are analysed. This discussion forms part of the justification for the need for public support for investments in the transport sector.

Demographic and macro-economic situation

The Republic of Kazakhstan is home to approximately 17 million people living on a territory of 2.7 million square kilometres. Fifty-three percent of the population lives in urban areas. Between 2000 and 2013, Kazakhstan experienced a 12.6% rise in its total population. In 2013, Kazakhstan had the second highest population increase, after Uzbekistan, among the countries of Eastern Europe, Caucasus and Central Asia (EECCA).

Figure 3.1. **Natural increase of the population in selected EECCA countries**



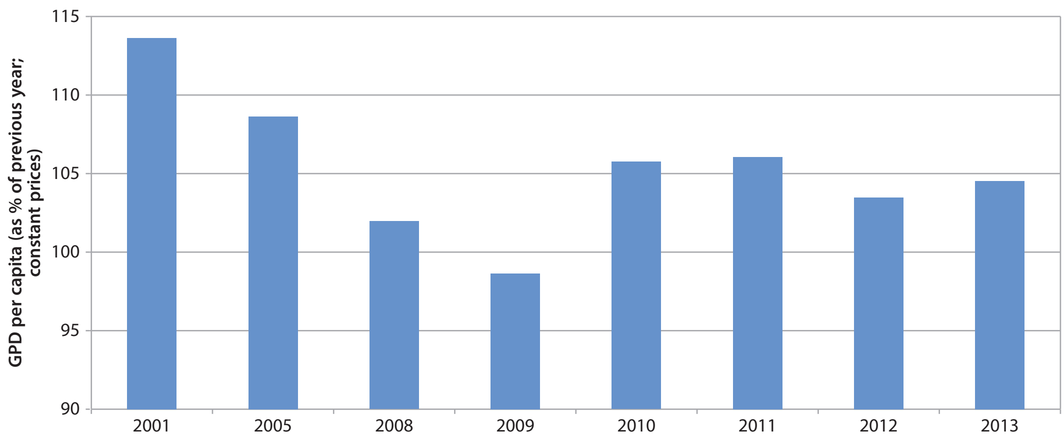
Source: CIS (2014).

Note: Georgia and Turkmenistan are not included in the graph.

After achieving independence in 1991, Kazakhstan shifted from lower-middle-income to upper-middle-income status in less than two decades, moving into the upper-middle-income group in 2006. Since 2002, GDP per capita has risen six-fold and the incidence of poverty has fallen sharply. The estimated GDP in 2015 was USD 173 bln, growing at a rate of 1.2%. This represents a slowing of GDP growth, after growth of 4.3% and 6% in 2014 and 2013, respectively. As shown in Figure 3.2, Kazakhstan's GDP per capita experienced dramatic reversals in the past decade, based on the economic recovery in early 2000s and a slowdown caused primarily by the global economic and financial crisis. Currently, the main short-term economic policy challenge is to adjust to the new reality of slower growth (as compared to the beginning of the previous decade) and possibly to lower income in the near future.

GDP is mostly generated by services (62.5%), followed by industry (32.5%) and agriculture (5%). In 2015, Kazakhstan ranked fifteenth in the world in crude oil production, at 1.65 mln barrels per day, and is one of the largest exporters of crude oil (ninth in 2013), at 1.47 mln barrels per day. The country's proven oil reserves, at 30 bln barrels, rank the 12th highest in the world. Kazakhstan ranks No. 32 in the world in the production of natural gas (21.3 bln m^3 in 2014) and is the 19th largest exporter (11.54 bln m^3). Its proven gas reserves (2.41 tln m^3) are the 15th highest in the world. Hydrocarbon output was the equivalent of nearly 18% of GDP and about 60% of exports in 2015.

Figure 3.2. **GDP per capita in Kazakhstan**



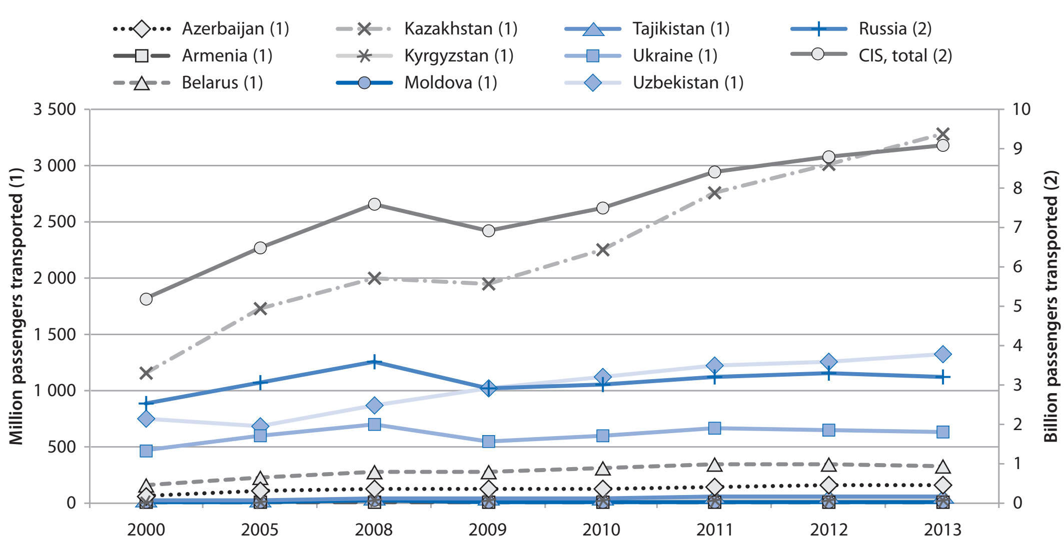
Source: CIS (2014).

In 2015, employment was mainly in services (62.3%), agriculture (25.8%) and industry (11.9%). The unemployment rate was only 5%, with only 5% of the population falling below the poverty line.

In 2015, the national budget collected revenues of USD 34.4 bln, while public expenditure stood at USD 37.1 bln. The budget deficit, as a percentage of GDP, was low, at 1.5%. Public debt as a percentage of GDP increased sharply, from 14.8% in 2014 to 24.1% in 2015. These figures are still well below levels of concern that would affect the country's capacity to invest and meet its debt obligations.

The booming economy of Kazakhstan since the early 2000s has had an impact on the growth of the transport and logistics industry in the country. This development has been further strengthened by increasing transit transport (e.g. through improved co-operation between the Russian Federation and China) or by introducing national investment programmes (e.g. the Nurly Zhol Programme). In the domestic transport sector, Kazakhstan ranks second within the EECCA countries in terms of number of passengers transported, second after the Russian Federation since 2010 (Figure 3.3).

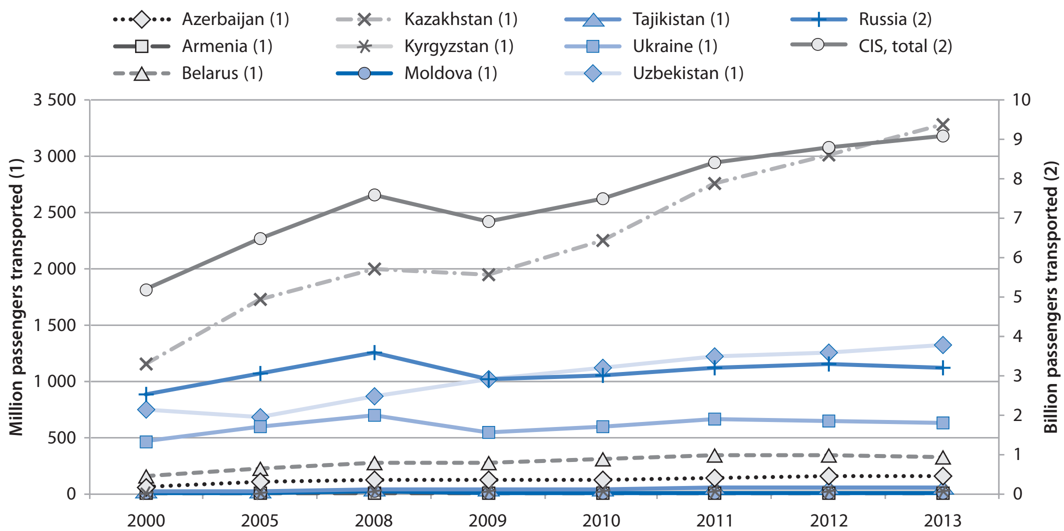
Figure 3.3. **Passenger transport by transport enterprises in Kazakhstan**



Source: CIS (2014).

The amount of transported goods rose in Kazakhstan from 1.2 bln tonnes in 2000 to 3.3 bln tonnes in 2013. Belarus and Azerbaijan, whose population is comparable to Kazakhstan's, transported a total of only 0.5 bln tonnes in 2013 (Figure 3.4).

Figure 3.4. **Cargo transport by transport enterprises in Kazakhstan, excluding pipeline transport**



Source: CIS (2014).

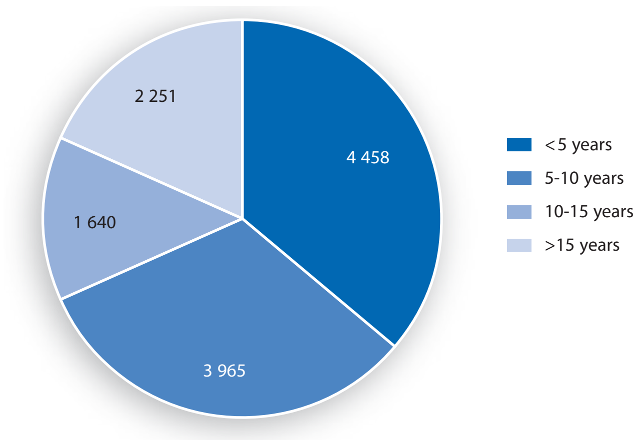
Whereas cargo transport is predominantly private, passenger transport includes both private and public transport. It might thus be argued that public transport (including city and intercity) is much less significant in terms of greenhouse gas (GHG) emissions and air pollution. On the other hand, while cargo and, to some extent, private passenger transport is predominantly long-distance (e.g. shipping natural resources), public transport is more concentrated in urban areas and has a more immediate effect on human health (see end of Chapter 3).

Kazakhstan's urban public transport system

For this study, the urban public transport systems of cities with a population of more than 100 000 inhabitants were analysed. As of the first half of 2016, 185 providers, of which four are utility companies, operate urban public transport systems in Kazakhstan. The total bus fleet comprises 12 314 buses, including 3 555 minibuses (about 29% of the total fleet). Of these, the transport providers own 6 258 vehicles, whilst the remaining 6 056 are leased or rented. Nearly one-third of the buses (31%) are more than 10 years old (Figure 3.5).

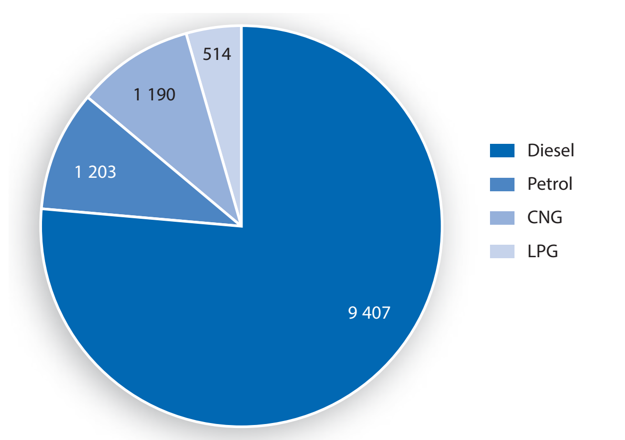
Within the analysed fleet, over three-quarters of the buses (76%) are diesel-powered. Compressed natural gas (CNG) and petrol-powered vehicles each constitute 10%, while liquefied petroleum gas (LPG) is used as a fuel in only 1 out of 25 (4%) vehicles (Figure 3.6).

Figure 3.5. **Public transport fleet composition by age (number of vehicles and % distribution of total)**



Source: Data collected by OECD from Oblast (region) Akimats.

Figure 3.6. **Public transport fleet composition by fuel type (number of vehicles and % distribution of total)**



Source: Data collected by OECD from Oblast (region) Akimats.

Table 3.1 summarises the available data on the vehicle fleet in selected cities of Kazakhstan. The cities of Kostanay and Shymkent are highlighted in bold. The dominance of old, diesel-powered buses in the fleet in Kostanay provides justification for its selection for the pilot phase of the programme. Shymkent, on the other hand, has many diesel-powered buses close to the 10-year threshold.

Table 3.1. **Bus public transport fleet of Kazakhstan, by age and fuel type (electric transport excluded)**

			No. of providers		Buses													
						Ownership		Size		By age (number of buses)				By fuel type (number of buses)				
Region	City	Pop. ('000)	Private	Public	Total	Owned	Leased	Mini buses	Large buses	>15 years	10-15 years	5-10 years	< 5 years	Diesel	Petrol	CNG	LPG
Akmola	Kokshetau	159.8	4	0	200	127	73	10	190	55 (27.5%)	82 (41%)	52 (26%)	11 (5.5%)	114 (57%)	72 (36%)	0	4 (2%)
Aktobe	Aktobe	397.5	2	0	552	531	21	21	531	6 (1%)	69 (12.5%)	324 (58.6%)	153 (27.7%)	443 (80.2%)	25 (4.5%)	0	84 (15.2%)
Almaty	Almaty	1 700	18	0	1 605	815	790			163 (10.2%)	205 (12.8%)	327 (20.4%)	910 (56.7%)[a]	868 (54.1%)	0	737 (45.9%)	0
	Taldykorgan	140.6	7	0	262	24	238			0	9 (3.4%)	87 (33.2%)	166 (63.3%)	262 (100%)			
Astana	Astana	872.6	8	1	1 119	962	157	53	1 066	117 (10.4%)	162 (14.4%)	351 (31.3%)	489 (43.6%)	1 119 (100%)			
Atyrau	Atyrau	226.1	11	0	234	95	139	91	143	0	56 (23.9%)	90 (38.4%)	88 (37.6%)	143 (61.1%)	50 (21.3%)	41 (17.5%)	
East Kazakhstan	Semey	318	6	0	635	110	525	553	82	48 (7.5%)	135 (21.2%)	93 (14.6%)	359 (56.5%)	535 (84.2%)	100 (15.7%)	0	0
	Ust-Kamenogorsk	321.5	10	0	814[b]	383	431	306	468	255 (31.3%)[c]	151 (18.5%)	314 (38.5%)	94 (11.5%)	632 (77.6%)	182 (22.3%)	0	4 (2%)
Karaganda	Karaganda	497.8	9	0	964	715	249	475	489	333 (34.5%)	30 (3.1%)	222 (23%)	379 (39.3%)	961 (99.6%)	3 (0.4%)	0	0
	Temirtau	178.3	9	0	245[d]	131	114	6	201	16 (6.5%)[e]	8 (3.2%)	146 (59.5%)	75 (30.6%)	116 (47.3%)	126 (51.4%)	0	3 (1.2%)
	Zhezkazgan	86.7	10	0	72	72	0	0	72	19 (26.3%)	23 (31.9%)	25 (34.7%)	5 (6.9%)	42 (58.3%)	20 (27.7%)	0	10 (13.8%)
Kostanay	Kostanay	231.9	9	0	427	296	131	8	419	421 (98.5%)	0	0	6 (1.4%)	427 (100%)	0	0	0
	Rudnyi	115.9	3	0	158	149	9		158	146 (92.4%)	4 (2.5%)	5 (3.1%)	3 (1.8%)	121 (76.5%)	7 (4.4%)	30 (18.9%)	0
Kyzylorda	Kyzylorda	227.4	0	1	759	70	689	368	391	326 (42.9%)	140 (18.4%)	223 (29.3%)	70 (9.2%)	432 (56.9%)	152 (20%)	105 (13.8%)	70 (9.2%)
Mangistau	Aktau	183.2	3	0	66	27	39	0	66	0	0	38 (57.5%)	28 (42.5%)	66 (100%)	0	0	0
	Zhanaozen	113.3	3	0	93	5	88	82	11	10 (10.7%)	10 (10.7%)	62 (66.6%)	11 (11.8%)	93 (100%)	0	0	0
North Kazakhstan	Petropavlovsk	215.3	11	0	346	218	128	182	164	197 (56.9%)	59 (17%)	75 (21.6%)	197 (56.9%)	231 (66.7%)	87 (25.1%)	0	26 (7.5%)
Pavlodar	Pavlodar	335.2	7	2	516[f]	197	319	332	73	106 (20.5%)[g]	63 (12.2%)	196 (37.9%)	151 (29.2%)	516 (100%)	0	0	0
	Eky-bastuz	134	3	0	55	55	0	0	55	17 (30.9%)	10 (18.1%)	4 (7.2%)	24 (43.6%)	55 (100%)	0	0	0

Table 3.1. **Bus public transport fleet of Kazakhstan, by age and fuel type (electric transport excluded)** *(continued)*

Region	City	Pop. ('000)	No. of providers: Private	No. of providers: Public	Buses: Total	Ownership: Owned	Ownership: Leased	Size: Mini buses	Size: Large buses	By age (number of buses): >15 years	By age: 10-15 years	By age: 5-10 years	By age: < 5 years	By fuel type (number of buses): Diesel	By fuel type: Petrol	By fuel type: CNG	By fuel type: LPG
South Kazakhstan	Shymkent	885.7	29	0	1 685	552	1133	492	1 193	61 (3.6%)	117 (6.9%)	880 (52.2%)	627 (37.2%)	1385 (82.1%)	0	200 (11.8%)	100 (5.9%)
	Turkestan	159.6	1	0	300	90	210	250	50	50 (16.6%)	120 (40%)	85 (28.3%)	45 (15%)	200 (66.6%)	0	100 (33.3%)	0
West Kazakhstan	Uralsk	232.4	7	0	675	219	456	269	406	56 (8.2%)	134 (19.8%)	238 (35.2%)	247 (36.5%)	317 (46.9%)	139 (20.5%)	219 (32.4%)	0
Zhambyl	Taraz	362.9	11	0	652	491	161	57	595	41 (6.2%)	93 (14.2%)	167 (25.6%)	351 (53.8%)	366 (56.1%)	230 (35.2%)	0	56 (8.5%)

Source: Data collected by OECD from Oblast (region) Akimats.

Notes: a. The average operation period of trolleybuses is 5 years.

b. Average operation period of trams is 30 years.

c. Including 40 trams.

d. The average operation period of trams is 28 years.

e. Including 38 trams.

f. Including 111 trams.

g. The average operation period of trams is 28 years.

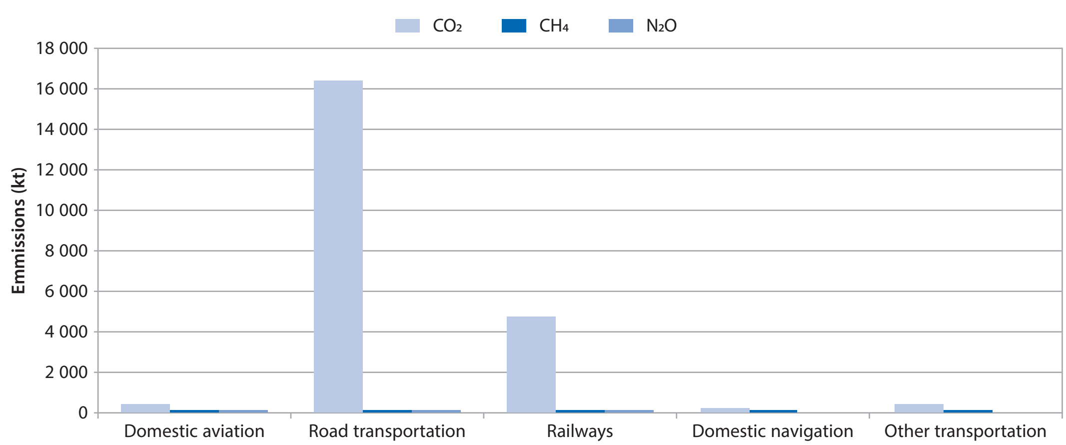
Greenhouse gas emissions and air pollution in Kazakhstan

Greenhouse gas emissions

According to the information presented by Kazakhstan to the United Nations Framework Convention on Climate Change (UNFCCC, 2016), the overall GHG emissions in 2014, excluding the land use, land-use change and forestry (LULUCF) sector, amounted to 313.8 mln tonnes of carbon dioxide (CO_2) equivalent, or 338.7 mln tonnes of CO_2 equivalent including the LULUCF sector (total net emissions). In the base year, 1990, total emissions of GHG excluding LULUCF amounted to 389.6 mln tonnes of CO_2 equivalent, or 373.3 mln tonnes of CO_2 equivalent including the LULUCF sector (total net emissions).

Despite a significant increase since 1998, total GHG emissions in 2014 were only 80.5% (excluding LULUCF) of the total amount in the base year, 1990 (Figure 3.7). Since Kazakhstan has made voluntary commitments to retain GHG emissions in 2020 at a level not lower than 15% below the base year level, GHG emissions can grow up to 5.5% from the current level, as long as they do not exceed the committed target.

Figure 3.7. **GHG emissions generated by the transport sector in Kazakhstan**



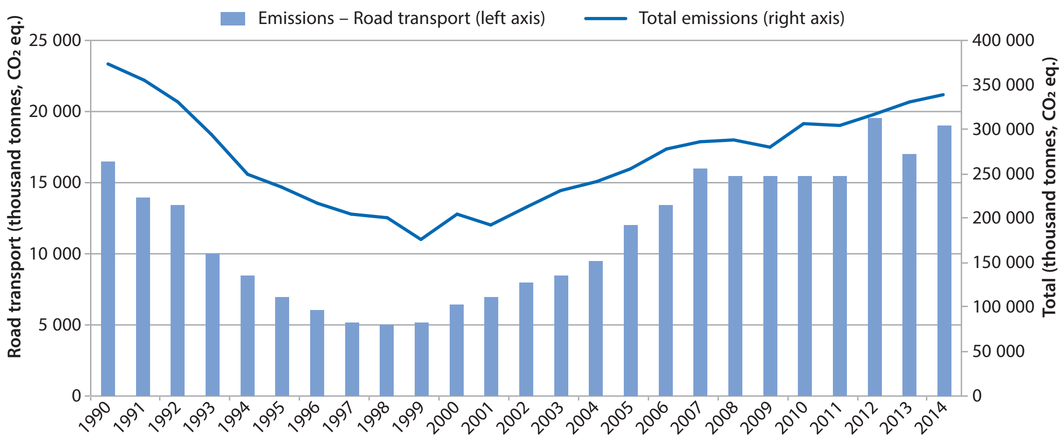
Source: National Inventory Submissions to the UNFCCC (UNFCCC, 2016).

The energy sector contributes the largest share (82.1%) of total emissions: 257.8 mln tonnes of CO_2 equivalent. Emissions from the transport sector are included in the energy sector. The industrial production sectors, agriculture and waste management, as well as the LULUCF sector, account for the remainder of the emissions.

In 2014, GHG emissions from the transport sector accounted for 21.6 mln tonnes of CO_2 equivalent (8.4% of GHG emissions from the energy sector). This includes emissions from the vehicle transport of 19.1 mln tonnes of CO_2 equivalent, or 88% of GHG emissions in the transport sector. This makes the automobile transport sub-category a key part of GHG emissions.

From 1990 to 1999, total GHG emissions from the road transport sector declined rapidly, mainly due to the deep economic crisis in the country at the time (Figure 3.8). After 1999, emissions steadily increased, almost reaching the 1990 level in 2007. In 2013, CO_2 equivalent emissions declined slightly, due to lower fuel consumption in the country, although the number of vehicles increased slightly in the same period. The amount of GHG emissions in the road transport sector increased from 2013 to 2014 by about 2 mln tonnes CO_2 equivalent emissions. Changing conditions in the domestic motor vehicle market, as well as the depreciation of cars in the Russian Federation (and their resale in Kazakhstan) substantially increased the number of automobiles in 2014.

Figure 3.8. **GHG emissions from motor vehicles in Kazakhstan compared to total emissions, 1990-2014**



Source: UNFCCC (2016).

Statistics for GHG emissions with a breakdown by city are not available, as the data on emissions are collected by companies without specifying the location of emissions.

Air pollution in the cities of Kazakhstan

The analysis of air pollution in Kazakhstan's cities is based on data from the 2015 information bulletin on the environment prepared by Kazakhstan's National Hydrometeorological Service (RSE Kazhydromet) which monitors air quality based on 25 pollutants (Kazhydromet and MoE, 2016). Kazhydromet assesses air pollution over the year using the air quality indicators described in Box 3.1.

Box 3.1. **Air quality assessment**

The amount of air pollution by type is estimated by comparing the actual concentration of a pollutant with its *maximum allowable concentration (MAC*, in mg/m³ or µg/m³):

- *Pollutant standards index (PSI):* the largest maximum single concentration of any pollutant measured in the city, divided by the MAC;
- *Maximum frequency (MF),* % in excess of MAC: maximum frequency in excess of MAC by any pollutant;
- *Air pollution index (API)* is calculated using the average values of the concentrations of various pollutants divided by the MAC and expressed as sulphur dioxide hazards.

Source: Kazhydromet and MoE (2016).

The degree of air pollution is characterised by standard scales for the PSI, MF and the API indicators (Table 3.2). If API, PSI and MF show different levels on the pollution scale, API is used for the overall assessment of the level of air pollution.[1]

Table 3.2. **Air pollution indices**

Degree			
Scale	Air pollution	Air pollution indicators	Annual estimates
I	Low	PSI MF, % API	0–1 0 0–4
II	Increased	PSI MF, % API	2–4 1–19 5–6
III	High	PSI MF, % API	5–10 20–49 7–13
IV	Very high	PSI MF, % API	> 10 > 50 ≥ 14

Source: Kazhydromet and MoE (2016).

The degree of air pollution in the cities of Kazakhstan is estimated by the three air pollution indicators, PSI, MF and API. In accordance with the API index scale, there are 14 cities with low levels of pollution, three cities with an increased level of pollution and five cities with a high level of pollution, namely, Ust-Kamenogorsk, Almaty, Zhezkazgan, Shymkent, Karaganda and Temirtau.

According to information from the Ministry of Energy of Kazakhstan and Kazakhstan's National Hydrometeorological Service (Kazhydromet and MoE, 2016), the cities in which motor vehicles are factors in air pollution are Astana, Almaty and Karaganda.

The description of air pollution in the cities of Kazakhstan is represented by the following key indicators of pollutant concentration:

- frequency of excess of the MAC of average impurity concentration;
- presence of 500 or more cases of excess of the MAC of an impurity;
- presence of 30 or more cases of 5-fold excess of the MAC of an impurity;
- presence of 1 or more cases of 10-fold excess of the MAC of an impurity.

Table 3.3. **Level of air pollution in large cities of Kazakhstan, 2015**

No.	City	PSI (level on pollution scale)	MF, %	API	PM	NO_x	Other (CO, SO_2)
					Exceedance of MAC – average annual concentration		
					Exceedance of MAC – number of occurrences		
1	Zhanaozen	2.2 (II)	12.8 (II)	1.4 (I)	-	-	-
					-	-	-
2	Kokshetau	2.8 (II)	14.6 (II)	2.5 (I)	PM – 1.9-fold	-	-
					-	NO_2 – 604	-
3	Uralsk	4.1 (II)	25.4 (III)	1.4 (I)	-	-	-
					PM – 4 326 cases	NO_2 – 558 cases	-

Table 3.3. **Level of air pollution in large cities of Kazakhstan, 2015** *(continued)*

No.	City	PSI (level on pollution scale)	MF, %	API	PM	NO_x	Other (CO, SO_2)
					Exceedance of MAC – average annual concentration		
					Exceedance of MAC – number of occurrences		
4	Turkestan	6.7 (III)	72.2 (IV)	0.9 (I)	PM – 2.5-fold	-	-
					PM – 3 767 cases	-	CO – 5-fold (30 cases)
5	Pavlodar	6.8 (III)	71.9 (IV)	4.3 (II)	PM – 1.5-fold	-	-
					-	NO_2 – 2 223 cases	-
6	Petropavlovsk	9.3 (III)	7.4 (II)	3.4 (I)	-	-	-
					-	-	-
7	Kyzylorda	9.99 (III/IV)	1.4 (II)	3.4 (I)	-	NO_2 – 1.2-fold	SO_2 – 1.6-fold
					-	-	-
8	Astana	10.2 (III/IV)	44.2 (III)	4.2 (I)	PM – 1.5-fold	NO_2 – 1.9-fold	-
					-	NO_2 – 757 cases and by 10-fold (2 cases)	-
9	Atyrau	10.3 (III/IV)	13.5 (II)	4.1 (I)	PM – 1.3-fold	-	-
					-	-	CO – 5-fold (257 cases)
10	Taldykorgan	17.3 (IV)	98.7 (IV)	3.6 (I)	PM – 4-fold	-	-
					PM – 4 326 cases	NO_2 – 2 160 cases	-
11	***Kostanay***	***18.5 (IV)***	***45.4 (III)***	***3.9 (I)***	***PM10 – 1.4 fold***	***NO_2 – 2.5 fold***	***-***
					-	***NO_2 – 2 754 cases NO – 6 764 cases and by 5-fold (70 cases)***	***SO_2 – 5-fold (50 cases) and by 10-fold (3 cases); CO – 25 cases***
12	Aktau	20.4 (IV)	75.3 (IV)	4 (I)	PM – 1.2-fold	-	-
					PM – 655 cases and by 10-fold (2 cases); PM10 – 1 case	-	-
13	Aktobe	29.9 (IV)	47.9 (III)	3.3 (I)	-	-	-
					-	NO_2 – 763 cases	-
14	Taraz	7.6 (III)	50.6 (IV)	5.5 (II)	PM – 1.1-fold	NO_2 – 1.5-fold	-
					-	NO_2 – 2 077 cases	CO – 5-fold (37 cases)
15	Semey	8.6 (III)	21.4 (III)	5.8 (II)	-	-	-
					-	-	-
16	Ekybastuz	10 (III/IV)	42.7 (III)	5.1 (II)	PM – 1.1-fold	-	-
					-	-	SO_2 – 5-fold (500 cases) and by 10-fold (12 cases)
17	Ust-Kamenogorsk	6 (III)	52.1 (IV)	7 (III)	PM – 4-fold	NO_2 – 1.2 times	SO_2 – 1.6 times
					PM – 4 326 cases	-	CO – 790 cases
18	Almaty	8.7 (III)	47.8 (III)	7.6 (III)	PM – 1.2-fold	NO_2 – 2.6-fold	-
					-	NO_2 – 10 118 cases and by 5-fold (83 cases)	-
19	Zhezkazgan	9.98 (III)	19.6 (II)	7.5 (III)	PM – 1.9-fold	-	-
					-	-	-
20	***Shymkent***	***17.3 (IV)***	***43.9 (III)***	***8.1 (III)***	***PM – 1.6-fold***	***NO_2 – 1.1-fold***	***-***
					PM10 – 968 cases and by 10-fold (1 case)	***NO_2 – 10 118 cases and by 5-fold (83 cases)***	***SO_2 – 5-fold – 32 cases NO_2 – 5-fold – 83 cases***

Table 3.3. **Level of air pollution in large cities of Kazakhstan, 2015** *(continued)*

No.	City	PSI (level on pollution scale)	MF, %	API	PM	NO_x	Other (CO, SO_2)
					Exceedance of MAC – average annual concentration		
					Exceedance of MAC – number of occurrences		
21	Temirtau	20.4 (IV)	27 (III)	7.9 (III)	PM – 2-fold	-	-
					-	NO_2 – 612 cases	-
22	Karaganda	25.6 (IV)	31.6 (III)	9.6 (III)	PM10 – 1.7-fold	-	-
					PM – 10-fold – 3 cases; PM10 – 1 100 cases; PM2.5 – 2 289 cases and by 5-fold (131 cases)	-	-

Source: Kazhydromet and MoE (2016).

The analysis of the air pollution data in the cities of Kazakhstan provides justification for a programme to reduce air pollution in urban areas. The replacement of outdated buses with modern diesel-powered or natural gas-powered buses would help reduce pollution of particulate matter, as well as NO_x and SO_2. Air pollution caused by particulate matter is associated with increased cardiopulmonary and lung cancer mortality. Increased air pollutants carry a risk of mortality, in particular among people of over 65 (Pope, 1995) (Box 3.2). A clean public transport programme could thus be justified from a public health standpoint.

Influence of air pollution from diesel engines on human health

Diesel engines, especially older ones, contribute to air pollution, which poses major environmental and health risks to the population. Above all, diesel exhaust is a Group 1 carcinogen, which causes lung cancer and has a positive association with bladder cancer. The Group 1 category is used when there is sufficient evidence of carcinogenicity in humans.

Diesel engines emit the following pollutants, described in Box 3.2 – carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and particulate matter (PM).

Box 3.2. **Diesel exhaust emissions**

Carbon dioxide (CO_2) – a greenhouse gas, CO_2 is non-toxic but causes climate change.

Carbon monoxide (CO) – CO is a temporary atmospheric pollutant in some urban areas, chiefly from the exhaust of internal combustion engines. Carbon monoxide is absorbed through breathing and enters the bloodstream through gas exchange in the lungs. It is toxic when encountered in concentrations above about 35 ppm.

Nitrogen oxides (NO_x) – NO_x refers to the mixture of NO and NO_2. They are produced during combustion, especially at high temperatures. Due to reactions and photolysis by sunlight, they are the main source of tropospheric ozone. NO_x may react with water to make nitric acid, which may end up in the soil, where it makes nitrate, which is of use to growing plants. NO_x in combination with other pollutants creates urban smog. High concentrations of nitrogen dioxide are harmful because they cause inflammation of the airways.

Sulphur dioxide (SO_2) – SO_2 pollution from diesel mainly depends on the quality of the fuel. If the fuel contains more sulphur, the diesel exhaust will contain more SO_2. Sulphur dioxide emissions are a precursor to acid rain and atmospheric particulates. Inhaling sulphur dioxide is associated with increased respiratory symptoms and diseases, and difficulty in breathing.

Box 3.2. **Diesel exhaust emissions** *(continued)*

Particulate matter (PM) – the major pollutants with negative health effects are PM (2.5 and 10). The particles are so small they can penetrate into the deep regions of the lungs. It is estimated that approximately 3% of cardiopulmonary and 5% of lung cancer deaths are attributable to PM globally. Exposure to PM2.5 reduces life expectancy by about 8.6 months on average.

PM pollution is estimated to cause 22 000 to 52 000 deaths per year in the United States (as of 2000), contributed to about 370 000 premature deaths in Europe in 2005 and 3.22 million deaths globally in 2010, according to a study of the global burden of disease (Lim et al., 2012).

The health effects of PM2.5 and PM10 are well documented. They are due to exposure over both the short term (hours, days) and long term (months, years) and include:

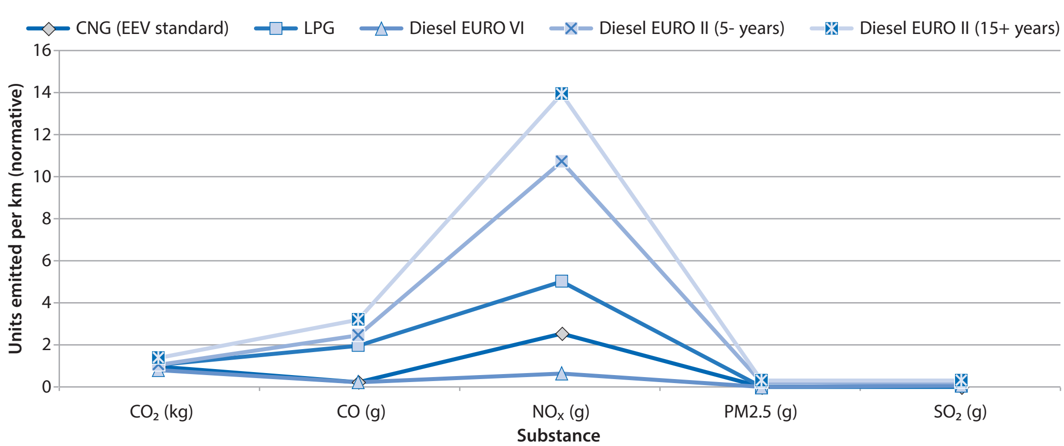
- respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms and an increase in hospital admissions;
- mortality from cardiovascular and respiratory diseases and from lung cancer.

There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur. The World Health Organization Air Quality Guidelines values for PM in 2005 (WHO, 2013) were as follows:

- for PM2.5: 10 $\mu g/m^3$ for the annual average and 25 $\mu g/m^3$ for the 24-hour mean (not to be exceeded for more than 3 days/year);
- for PM10: 20 $\mu g/m^3$ for the annual average and 50 $\mu g/m^3$ for the 24-hour mean.

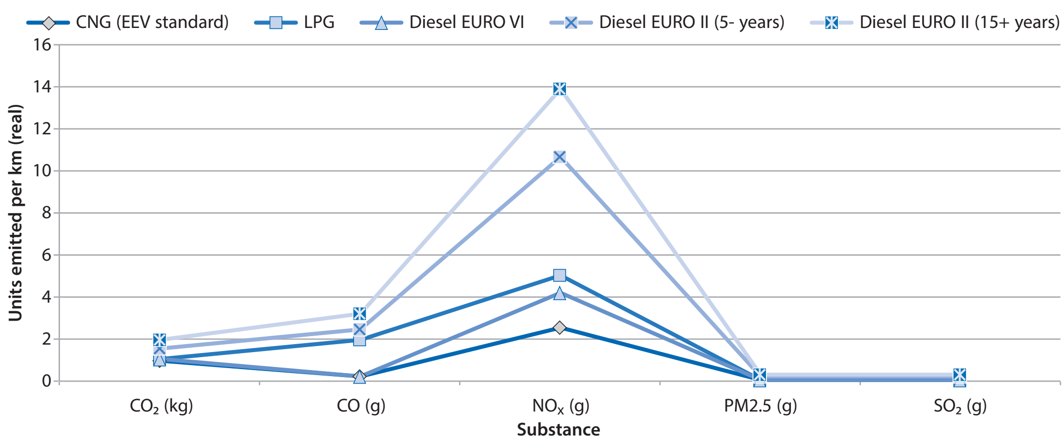
Figures 3.9 and 3.10 depict graphically the increased emissions of health-damaging substances that old diesel-powered engines (especially ones of more than 15 years and older) generate in comparison with modern diesel engines and alternative fuels, CNG and LPG.

Figure 3.9. **Assumed amount of health-damaging substances emitted per distance travelled (normative)**



Source: DieselNet (2016).

Figure 3.10. **Assumed amount of health-damaging substances emitted per distance travelled (real)**



Source: DieselNet (2016).

Conclusions for the CPT Programme

The analysis of the urban bus transport system and air pollution data in the major 23 cities of Kazakhstan provides further justification for the project.

As of the first half of 2016, 185 providers – of which 4 are utility companies – operate urban public transport systems in Kazakhstan. The total bus fleet comprises 12 314 buses, including 3 555 minibuses. Of these, the transport providers own 6 258, whilst the remaining 6 056 are leased or rented. Nearly one-third of the buses are 10 years or older, and just over three-fourths are diesel-powered.

The replacement of outdated buses with modern diesel-powered or natural gas-powered buses would help reduce pollution of particulate matter, as well as NO_x and SO_2. Particulate air pollution is associated with increased cardiopulmonary and lung cancer mortality. Increased air pollutants carry a risk of mortality, in particular for people of over 65. The CPT Programme could thus be justified from a public health standpoint.

Note

1. To calculate the API, the first five pollutants that have the highest magnitude of excess over the MAC are taken and expressed in terms of SO_2, applying a coefficient to each pollutant depending on the hazard rate compared to SO_2. These values are then totalled. In the two pilot cities, Kostanay and Shymkent, two and four pollutants exceed the MAC, respectively.

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Chapter 4

Policy and regulatory framework for the transport sector

This chapter briefly discusses the regulatory framework for urban public transport including technical, emissions and energy-efficiency requirements – both of the Eurasian Customs Union and the Republic of Kazakhstan – that urban public transport vehicles need to meet. The chapter also looks at some public finance aspects related to urban public transport in Kazakhstan. All these issues are discussed in the context of the extent to which existing policies and regulations create demand for green investments in the public transport sector.

Regulatory framework for urban public transport in Kazakhstan

Organisation of urban public transport and upgrade of the bus fleet

The urban public transport system of Kazakhstan is subject to the Law on Automobile Transport (PoK, 2003) and the Rules for Transport of Passengers and Baggage by Automobile Transport in the Capital (GoK, 2007a).

The Law on Automobile Transport (PoK, 2003) regulates transport of passengers provided by carriers using buses,[1] minibuses,[2] and trolleybuses according to agreed routes and schedules. Buses and minibuses must comply with the requirements of national standards. Buses, microbuses, trolleybuses belong to category M2 and M3 vehicles depending on their weight, with those heavier than 5 tonnes belonging to the latter category. Both M2 and M3 classes must have more than eight seats, excluding the driver's seat (see Table 4.1).

Table 4.1. **Bus classes according to category and capacity**

Category	Capacity	Class	Description
M2, M3	< 22 passengers	A	Designed for sitting + standing passengers
		B	Designed for sitting passengers only
M2, M3	> 22 passengers	I	Designed as having a special space for standing passengers and quick change of passengers
		II	Designed mostly for sitting passengers + standing passengers in space not exceeding twice the size of a passenger seat
		III	Designed for transport of sitting passengers only

Source: EACU (2011).

The Rules for Transport of Passengers and Baggage by Automobile Transport (GoK, 2007a) set out which entities may organise a tender for providing services on transport routes (for example, local oblast executives, executive of the city of Astana or Almaty, etc.). The successful tenderer is selected based on a point system comprising the bid price and maintenance of service quality and passenger safety. The final score also depends on the age of the buses and microbuses provided. In the event of tie scores, preference is given to providers using vehicles produced domestically.

Further, local authorities have the right to set lower fares than those provided in the bid, prepared according to the methodology for calculating fares for transporting passengers and luggage. If the fares established by local authorities do not cover the cost of transport, the provider is reimbursed for the difference from the corresponding local budget. The Rules also establish the standard contract for service provision.

Kazakhstan's Standard Contract for Organisation of Regular Automobile Transport of Passengers and Baggage (MID, 2015a) sets the limits of age for buses, minibuses and trolleybuses used on the route. According to Item 3 of the standard contract, transport providers are obliged to upgrade (replace) buses, minibuses and trolleybuses used on the route not later than two years from the limits imposed in accordance with a table in the contract (see Table 4.2).

These are part of a standard contract between the regional or municipal executive authorities and the transport service provider. For example, if there are 2 or 3 buses on one route, 50% of the buses may be from 7 to 12 years old and the remainder should be less than 7 years old. Buses older than 12 years are not allowed to be used on that route. On the routes where there are 51 or more buses, 44% of them should be less than 7 years old, 20% may be 7 to 12 years old, 21% from 12 to 15 years old, and 15% more than 15 years old. If the thresholds are exceeded, the older buses must be replaced with newer models, though not necessarily new buses. Astana is an exception, since according to the Rules for Transport of Passengers and Baggage by Automobile Transport (MID, 2015b), buses with a useful life of not more than 14 years are permitted to operate on regular routes in that city.

Table 4.2. **Upgrading schedule for buses, minibuses and trolleybuses under standard contracts**

Age of buses, minibuses, trolleybuses	Quantity of buses, minibuses, trolleybuses						
	2-3	4-6	7-10	11-15	16-25	26-50	51 and more
up to 7 years	+	+	+	+	+	+	+
from 7 to 12 years	50%	25%	20%	20%	20%	20%	20%
from 12 to 15 years	-	25%	25%	25%	24%	22%	21%
more than 15 years	-	-	-	4%	6%	10%	15%

Notes: + buses, minibuses, trolleybuses are allowed to operate on the route;

- buses, minibuses, trolleybuses are not allowed to operate on the route;

When converting the percentage into the exact quantity of buses, minibuses and trolleybuses, a fraction of 0.5 and higher is rounded upwards (starting from the quantity of 1 bus, minibus or trolleybus).

State transport programmes (budget programmes with an urban public transport component)

The **State Programme for Infrastructure Development "Nurly Zhol" for 2015-19** (EO PoK, 2016) set a target that 96% of the settlements with a population of more than 100 people were to have regular bus routes by 2019. Some experts have expressed concern about this indicator and consider it insufficiently defined and unrealistic given the timeframe. For example, in other countries, a typical indicator related to the accessibility of bus services is the proportion of households in rural areas with access to a bus stop located at a distance of no more than 800 metres and providing hourly or daily service. It is unlikely that an indicator of 96% could be achieved in the short to medium term. In addition, the programme provides that the share of depreciated buses on regular passenger routes should be progressively reduced to 50% by 2019 (EO PoK, 2016).

Table 4.3 provides the upgrade schedule for buses, according to a standard contract between the regional or municipal executive authorities and the transport service provider.

Table 4.3. **Schedule for reduction in the share of outdated buses on regular passenger routes**

Indicator	2016	2017	2018	2019
Reduction in percentage of buses that are beyond their useful life on regular passenger routes	65%	60%	55%	50%

Source: EO PoK (2016).

Technical and emission requirements for buses

Several technical and emissions regulations govern urban public transport in Kazakhstan: the types, origins, year of manufacture and emission classes of buses in operation.

Technical Regulations of the Customs Union (TR CU 018/2011) "On Safety of Wheeled Vehicles" (EACU, 2011) set out the permitted classes of emission typical of the design of a vehicle or combustion engine, depending on emissions and requirements for on-board diagnostics systems. The requirements of the Technical Regulations are harmonised with the requirements of the Rules of the European Economic Commission of the United Nations (UNECE), and the Global Technical Regulations.[3]

The Order of the Ministry of Investments and Development of the Republic of Kazakhstan "On Approval of Limits of Vehicles Designed for Road Travel" (MID, 2015c) sets quotas for the emission of (polluting) substances by vehicles released for circulation in Kazakhstan. The Order provides a schedule by country of origin, year of manufacture and emission class.

The regulations also specify emission standards for buses with petrol, gas and diesel engines. Currently, Euro IV apply to all category M2, M3 vehicles (Table 4.4). Euro V standards for buses with gas or diesel engines will come into force on 1 January 2018.

Table 4.4. **Emission requirements for buses with petrol-powered engines**

Emission class	Levels of emissions
3	CO – 20 g/kWh, HC – 1.1 g/kWh, NO_x – 7 g/kWh (when testing as per the UNECE Rules No. 49-04, ESC test cycle)
4	CO – 4 g/kWh, HC – 0.55 g/kWh, NO_x – 2 g/kWh (when testing as per the UN ECE Rules No. 49-05, ESC test cycle)

Source: EACU (2011), Appendix 3.

Currently, the acting standards for hybrid buses are Euro IV.

Table 4.5. **Emission requirements for hybrid transport vehicles and power units**

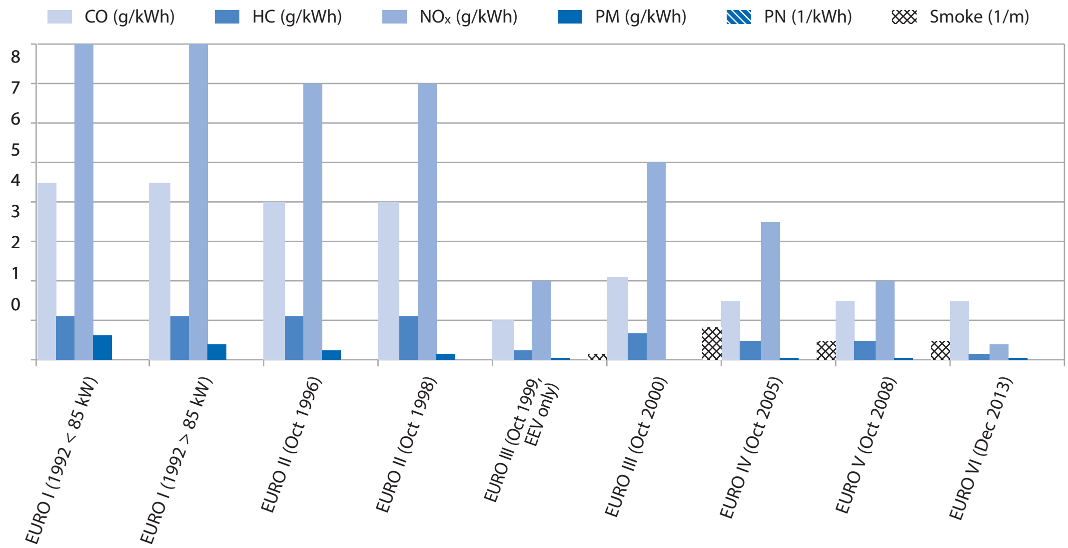
Emission class	Maximum emissions values				
	CO g/kWh	NMHC g/kWh	CH_4 g/kWh	NO_x g/kWh	PM g/kWh
4	4.0	0.55	1.1[a]	3.5	0.03[b]
5	4.0	0.55	1.1[a]	2.0	0.032[b]

Source: EACU (2011), Appendix 4.

Notes: a. Only for engines operating on compressed natural gas.
b. Only for engines operating on diesel fuel.

The Technical Regulations on the Requirements for Emissions of Harmful (Polluting) Substances of Vehicles, Emitted on the Territory of the Republic of Kazakhstan (GoK, 2007b) provide a schedule for confirmation of compliance with emission class requirements of vehicles released for circulation in Kazakhstan. These are carried out in accordance with the schedule provided in the Technical Regulations, depending on country of origin, year of manufacture and emissions class.

Figure 4.1. **Development of European emissions standards**



Source: DieselNet (2016).

Table 4.6 presents a comparison of timelines of introduction of the Euro emission standards in the European Union (EU) and in Kazakhstan.

Table 4.6. **Introduction of European emissions standards in the EU and in Kazakhstan**

Emission standards	EU		Kazakhstan	
Euro 1/I	July 1992	For passenger cars –91/441/EEC Also for passenger cars and light trucks – 93/59/EEC		
	1992	For trucks and buses (heavy duty diesel engines)		
Euro 2/II	January 1996	For passenger cars – 94/12/EC (and 96/69/EC) For motorcycles – 2002/51/EC (row A) – 2006/120/EC	July 2009	For all vehicles produced and imported to Kazakhstan
	October 1996 October 1998	For trucks and buses (heavy-duty diesel engines)	January 2010	Fuel sold in Kazakhstan
Euro 3/III	January 2000	For any vehicle – 98/69/EC For motorcycles – 2002/51/EC (row B) 2006/120/EC	January 2011	For all vehicles produced and imported into Kazakhstan
	October 1999 (EEVs only) October 2000	For trucks and buses (heavy-duty diesel engines)	January 2014	Fuel sold in Kazakhstan
Euro 4/IV	January 2005	For any vehicle – 98/69/EC (and 2002/80/EC)	July 2013	For all vehicles produced and imported into Kazakhstan
	October 2005	For trucks and buses (heavy-duty diesel engines)	January 2016	Fuel sold in Kazakhstan

Table 4.6. **Introduction of European emissions standards in the EU and in Kazakhstan** *(continued)*

Emission standards	EU		Kazakhstan
Euro 5/V	September 2009	For light passenger and commercial vehicles – 715/2007/EC	
	October 2008	For trucks and buses (heavy-duty diesel engines)	
Euro 6/VI	September 2014	For light passenger and commercial vehicles – 459/2012/EC	
	December 2013	For trucks and buses (heavy-duty diesel engines)	

Source: DieselNet (2016) and authors' research.

Customs taxes on imported vehicles

Customs taxes in the Eurasian Economic Union (EAEU) on vehicle imports, namely buses, are determined in the Single Customs Tariff, Group of Products 87, for land vehicles (EACU, 2012). These tariffs range from 0 to 15%. A zero percent tariff is set for Euro IV and V vehicles of special size and capacity.

Energy efficiency and fuel efficiency standards

Kazakhstan does not have a specific policy for developing low-emission transport. **The Concept for Transition of the Republic of Kazakhstan to a Green Economy** (the Concept) (EO PoK, 2013) and **Kazakhstan 2050 Strategy** (EO PoK, 2012), however, set an energy-efficiency goal to reduce the energy intensity of GDP by 10% by 2015 and by 25% by 2020 compared to the 2008 baseline. Kazakhstan uses two to three times more energy than the average for the OECD countries (IEA, 2016). Kazakhstan's rank in energy intensity varies depending on the source, but it is among the highest in the world.

The Concept defines the key measures for enhancing energy efficiency in the transport sector as: development of energy-efficient transport infrastructure, improvement of the efficiency of railway transport, and energy-efficiency enhancement of local public transport by shifting to clean fuel (gas and electricity). The high energy intensity in the transport sector is due chiefly to the following factors:

- 80% of motor transport has been in service for over 10 years;
- 87% of total energy is consumed by road transport;
- over 70% of traffic in large cities is generated by cars;
- 8% to 11% of the cost of goods is due to transport costs (in developed countries, this indicator usually does not exceed 4%) (UNDP, 2015).

The **Law on Energy Saving and Energy Efficiency Improvement** of 13 January 2012 regulates public relations and defines the legal, economic and organisational bases of activity of individual and legal entities in terms of energy conservation and energy efficiency enhancement (PoK, 2012). Based on this law, the Order of the Ministry of Investments and Development of Kazakhstan **On Determining the Requirements for Energy Efficiency of Transport** (MID, 2015d) was adopted in 2015. The Order sets the energy-efficiency indicators for vehicles (Table 4.7).

Table 4.7. **Energy-efficiency indicators for vehicles by type of engine**

No.	Type of engine	Energy efficiency in %
1	Natural gas engine	66
2	Diesel engine	55
3	Petrol engine	60
4	Hybrid vehicle (petrol/electric)	75.7
5	Electric motor	52.5

Source: MID (2015d), CAREC (2013).

Conclusions for the CPT Programme

The Rules for Transport of Passengers and Baggage by Automobile Transport (MID, 2015b) together with the standard contract provide the framework and opportunity to replace old, outdated bus fleets with modern buses powered by cleaner fuels. Since the majority of transport vehicles now directly depend on oil for fuel, consumption and CO_2 emissions are positively correlated. Any action to increase fuel efficiency will thus positively impact urban air quality. A targeted investment programme could be designed to offer bus owners incentives to invest in new fleets and take advantage of the savings in operating costs.

Regulatory framework for air pollution

One of the objectives of the Concept for Transition of the Republic of Kazakhstan to Green Economy is to improve the welfare of the population and reduce environmental pollution. To achieve this goal, the Concept suggests the development of energy-efficient transport infrastructure and increasing energy efficiency of local public transport by conversion to clean fuel (such as gas) through the following measures:

- introduction of a modern transport fleet, together with the improvement of methods of operation of vehicles, increasing the efficiency of fuel balance and operating activities;
- starting from July 2016, adoption of regulations on air emissions from motor vehicles, in accordance with European standards;
- conducting regular annual inspections of cars on the quality of exhaust gases with the completion of a one-time audit of all available vehicle fleets by 2020 (this will be particularly important to the success of any programme, as the results need to be reliable and verifiable);
- transition of urban transport in the city of Almaty to compressed natural gas;
- transition of urban transport to gas in other large cities (Astana, Karaganda, Shymkent) by 2020, depending on gas resources and the decisions made on how to subsidise gas prices.

Legislation on air pollutants

The Environmental Code of the Republic of Kazakhstan is the main legislation regulating atmospheric emissions, including greenhouse gases (GHG) (PoK, 2007). It includes the provisions of a number of UN conventions, which include the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the Paris Agreement under the UNFCCC. Kazakhstan is Party to Annex I, for the purposes of Kyoto Protocol in accordance with paragraph 7 of Article 1 of Kyoto Protocol, but is not Party to Annex I for the purposes of the Convention. In July 2016, Kazakhstan signed the Paris Agreement.

The Environmental Code defines the procedure for determining environmental emission standards. The maximum allowable concentrations (MAC) of air pollutants of populated areas are approved by the sanitary rules and regulations of the Republic of Kazakhstan on Approval of the Hygienic Standards for Atmospheric Air in Urban and Rural Areas (MNE, 2015).

The Environmental Code does not establish standards for mobile sources of air pollution emissions. Critical concentrations of the main air pollutants in the exhaust gases are defined through technical regulations. For example, the Order of the Ministry of Energy of Kazakhstan No. 26 of 21 January 2015 (MoE, 2015) approves the list of air pollutants and types of wastes for which emission standards are established.

Chapter 9 of the Environmental Code is devoted entirely to the emissions of greenhouse gases. It describes the mechanisms for the reduction of GHG emissions and the operation of the emissions trading scheme. It also explains the procedure for establishing and distributing quotas and inventorying greenhouse gas emissions. However, it only concerns stationary sources of pollution. Similarly, the inventory is taken only from stationary sources, and mobile sources of pollution are not considered.

Nationally Appropriate Mitigation Actions

On 28 September 2015, on the eve of COP21 in Paris (the Conference of the Parties to the UNFCCC), Kazakhstan submitted to the UNFCCC Secretariat its “Intended Nationally Determined Contribution” (INDC) (UNFCCC, 2016). The INDC sets out the expected environmental goals and actions after 2020. The main goals include (GoK, 2015):

- unconditional goal – 15% reduction of GHG emissions by 31 December 2030 in comparison to the baseline year 1990;
- conditional goal – 25% reduction of GHG emissions by 31 December 2030 in comparison to the baseline year 1990, subject to additional international investment, access to the mechanism for the transfer of low-carbon technologies, green climate funds and the mechanism of “flexibility” as a country in transition.

Nationally Appropriate Mitigation Actions (NAMAs) refer to a set of policies and actions that countries undertake as part of a commitment to reduce greenhouse gas emissions. These can be various policies aimed at transformational changes within a single sector or across two or more sectors of the economy. Developed countries can support the implementation of NAMAs in developing countries through financing technologies or capacity-building activities.

The UNFCCC website provides a NAMA Register, a publicly accessible platform for the placement of all NAMAs of all countries. This makes it possible to inform the public of the need for financial or other support for the development or implementation of NAMAs, if there is such a need.

The UNFCCC Register contains 2 NAMA projects for Kazakhstan, namely:

- “Fostering Use of Natural Gas in the Transport Sector of Kazakhstan” in the section “NAMA Seeking Support for Implementation” (MoE, 2013), implementing agency – KazTransGaz Onimderi LLP.

The project involves the shift from the use of petrol and diesel fuel to natural gas in the transport sector, by developing the necessary infrastructure for compressed natural gas (CNG) in the country by creating a network of 35 to 100 CNG filling stations. The project concept is presented in the report on the technical assistance of the Asian Development Bank on “Economics of Climate Change in Azerbaijan, Kazakhstan and Uzbekistan: The Economics of Reducing Greenhouse Gas Emissions in the Energy and Transport Sectors”

(ADB, 2015). The total project cost is about USD 74 mln, with expected international support of about USD 49 mln. The project has not yet received support.

- "NAMA for Low-Carbon Development of Kazakhstan", in the section "NAMA Seeking Support for Implementation" (MoE, 2014), implementing agency – United Nations Development Programme (UNDP).

The project aims to implement measures that reduce GHG emissions in the urban sector, through investments in urban infrastructure (in energy-efficient homes, energy-efficient transport and transport infrastructure, as well as waste management systems). This project has received support from the Global Environment Facility (GEF) for the development of a full-size UNDP-GEF project proposal (total project cost USD 150 000).

Conclusions for the CPT Programme

The Concept for Transition of the Republic of Kazakhstan to Green Economy is the main policy justification for the investment programme. The Concept provides for the development of energy-efficient transport infrastructure and increased energy efficiency of local public transport by conversion to clean fuel (such as gas) through the implementation of specific measures aimed at modernising the transport fleet, while applying European emission standards, inspection of vehicle fleets, and transitioning to CNG in large cities such as Almaty, Astana, Karaganda, and Shymkent by 2020.

Notes

1. A bus is defined as a vehicular transport designed to transport passengers and baggage that has more than eight seats, excluding the driver's seat.
2. A minibus is defined as a small class bus with at least 16 manufacturer-installed seats, excluding the driver's seat.
3. UNECE regulations created under the provisions of Article 6 of the 1998 Agreement concerning the Establishment of Global Technical Regulations for Wheeled Vehicles, Equipment and Parts Which Can be Fitted and/or Be Used on Wheeled Vehicles (UNECE, 1998).

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Chapter 5

Market analysis of clean fuels and technologies

This chapter analyses the market for clean technologies and fuels in the bus transport sector in Kazakhstan and on this basis assesses the viability of the investment programme. More specifically, the chapter reviews the:

- *market for compressed natural gas and liquefied petroleum gas as transport fuels;*
- *domestic production and import of buses used for urban transport, including prices;*
- *current fares for urban bus transport; and*
- *available co-financing for investment projects.*

The market analysis was undertaken to determine the need for the programme and its focus and scope. This analysis reviews the current situation of Kazakhstan's existing bus fleet (ownership status, age, fuel type used), the market for compressed natural gas (CNG) and liquefied natural gas (LNG) as transport fuels, domestic production and import of buses, bus fares for urban transport, and available co-financing for investment projects.

The Concept of Development of the Gas Sector of the Republic of Kazakhstan till 2030 (GoK, 2014) is designed to stimulate domestic demand for natural gas and add new categories of consumers, by implementing a range of market development activities. As part of these activities, this Concept envisages the construction of filling station networks and other measures encouraging a shift toward natural gas (CNG and LPG) in cars and public transport.

Overview of clean technologies and fuels in the bus transport sector

This section provides an overview of information on buses that run on four main clean fuels, namely:

- compressed natural gas;
- liquefied petroleum gas;
- diesel with Euro VI engines;
- electricity.

For a description of each fuel type and its main features, comparative advantages and drawbacks of the respective technology and its market penetration, both in Kazakhstan and worldwide, see Annex A.

Compressed natural gas (CNG)

CNG is used in traditional petrol/internal combustion engine automobiles that have been modified or in vehicles specially manufactured for CNG use. Although vehicles can use natural gas as either a liquid – LNG or a gas – CNG, most vehicles use the gaseous form. CNG vehicles have been introduced in a wide variety of commercial applications, from light-duty to medium-duty and even heavy-duty vehicles.

CNG combustion produces fewer undesirable gases than other fuels and is safer in the event of a spill, because natural gas is lighter than air and disperses quickly when released. On the other hand, CNG vehicles require bigger fuel tanks than conventional petrol-powered vehicles and the cost of fuel storage tanks is a major barrier to rapid and widespread adoption of CNG as a fuel.

Liquefied petroleum gas (LPG)

Also known as propane-butane, LPG is a flammable mixture of hydrocarbon gases used as fuel in heating appliances, cooking equipment and vehicles. In some countries, LPG has been used since the 1940s as an alternative to petrol for spark ignition engines.

LPG has a lower energy density than either petrol or fuel oil, so the equivalent fuel consumption is higher by about 10%. Many governments impose less tax on LPG than on petrol or fuel oil, which helps offset the greater consumption of LPG.

LPG burns more cleanly than petrol or fuel oil – causing less wear on engines – and is especially free of the particulates present in the latter.

Diesel with Euro VI engines

Diesel engines are one of the most common combustion-engine choices for buses and other commercial vehicles, globally. For the time being, buses that run on diesel and biodiesel – and brought to the market mainly by blending with conventional diesel – constitute by far the largest part of the bus fleet.

A standard diesel city bus delivers lower carbon emissions per rider, and reducing CO_2 emissions can be achieved by encouraging more passengers to shift to public transport.

On the other hand, a shift from Euro V to Euro VI for heavy-duty vehicles will require considerable investments for manufacturers and public transport agencies and demand a major outlay by bus manufacturers. It also has a significant environmental cost in the form of particulate matter (PM) from engine exhaust.

Electricity

Due to current limits in battery capacity and in driving range (generally 100-200 kilometres for a small to medium-sized car), electric vehicles are at present best suited to urban and suburban driving. An urban bus can have a range of 200 kilometres per charge, but the full battery electrification of heavy-duty vehicles and long-haul bus and coach fleets is not likely to be a realistic option in the near future. The trolleybus is a viable electrically-powered vehicle for reducing emissions.

Conclusions for the CPT Programme

Our analysis shows that buses with modern diesel, CNG or LPG-powered engines provide a suitable replacement for outdated and fully depreciated diesel models currently in operation in Kazakhstan. New models of diesel, CNG or LPG-powered buses offer savings in operating costs (due to lower maintenance costs) compared to old, diesel-powered models. In addition, CNG and LPG-powered buses have additional operating cost savings compared to diesel buses, given the lower price of this type of fuel.

Table A.3 presents a comparison of key parameters, as well as advantages and disadvantages of CNG, LPG, and diesel fuel to power buses. CNG may require additional infrastructure in some cities. It is also important to point out that diesel buses need special equipment to ensure that emission reductions be met. This equipment increases operating costs, leading some operators to dismantle the equipment. This practice should be discouraged and avoided.

The market for compressed natural and liquefied petroleum gas in Kazakhstan

This section reviews the CNG and LPG markets in Kazakhstan, including related legislation and policy documents.

Policy documents on transition to gas fuel

The Concept for Transition to Green Economy defines the improvement of energy efficiency of local public transport, including the use of clean fuel (e.g. gas) as one of the main energy-efficiency measures in the transport sector (EO PoK, 2013).

One of the tasks of the **Concept of Development of the Gas Sector of the Republic of Kazakhstan till 2030** is to stimulate domestic demand for natural gas, and introduce it to new categories of consumers, by implementing a range of market development activities (GoK, 2014). The Concept assumes that by 2030, annual gas consumption from road, rail and sea transport will reach 0.5 bln m^3. As part of market development activities, the Concept envisages the construction of filling station networks and the implementation of measures to encourage the shift of cars and public transport toward natural gas (CNG and LPG). Target indicators of development have been identified and subject to state support measures, the Concept envisions the following target levels for use of these fuels in public road transport:

- By 2020:
  - in Almaty and Astana – no less than 30%;
  - in regional centres – no less than 10%.
- By 2030:
  - in Almaty and Astana – no less than 50%;
  - in regional centres – no less than 30% (GoK, 2014).

The Comprehensive Plan for the Development of Gasoline Fuel Market until 2020 has been adopted, but it only covers activities requiring the provision of relevant information to the authorised body (MoE, 2015).

Technical requirements for fuel

The main document that regulates fuel standards is the Technical Regulations of the Customs Union TR CU 013/2011 "On Requirements for Automobile and Aviation Petrol, Diesel and Marine Fuel, Jet Fuel and Heating Oil" (EACU, 2011). This technical regulation does not allow the use of petrol of ecological class K2 (Euro II) on the territory of the Customs Union (EACU, 2011). However, a recent amendment to the technical regulations, Decision No. 84 (EEC, 2015), granted an extension on the use of petrol of ecological class K2 and K3 in Kazakhstan until 1 January 2018. After this date, Kazakhstan should start using petrol of K4 (Euro IV) and K5 (Euro V) ecological classes.

As for diesel fuel, using diesel of ecological class K2 (Euro II) or K3 (Euro III) on the territory of the Customs Union is not allowed. In Kazakhstan, however, the ban will come into force on 1 January 2018. After this date, Kazakhstan should switch to diesel fuel of environmental classes K4 (Euro IV) and K5 (Euro V).

LPG is regulated by the Eurasian Economic Union's "Requirements for Liquefied Hydrocarbon Gases for Use as Fuel", adopted in August 2016 (EEC, 2016). This regulation will come into force on 1 January 2018. With regard to CNG, and according to the Plan of Development of Technical Regulations of EAEU, the Eurasian Economic Union will prepare technical regulations "On the Security of Natural Gas Fuel Prepared for Transport and (or) Use".

Analysis of LPG and CNG markets

This section contains information on the geographical availability of gas in Kazakhstan, volumes of produced, consumed and imported fuel, fuel prices and imports, production and prices of "clean" buses.

Geographic availability

In accordance with the Concept of Development of the Gas Sector till 2030, the largest gas pipelines in the country were built for the transit of Central Asian gas toward the Russian Federation and, later, China. The share of transit in the total volume of gas transport is 80%. In addition, gas pipelines are used for internal transport. The gas pipelines are mainly concentrated in the western and southern regions of the country (GoK, 2014).

Volume of fuel produced, consumed and imported

In 2015, the production of natural gas in gaseous and liquid form was 45 506.5 mln m^3 (Table 5.1), including:

- natural gas in gaseous form: 21.49 bln m^3, of which 12.01 bln m^3 is marketable gas;[1]
- liquefied natural gas: 251 mln m^3;
- associated petroleum gas, excepting petroleum gases obtained during distillation of crude oil: 23.76 bln m^3.

Table 5.1. **Production of natural gas in gaseous and liquid form, 2013-16, million m^3**

	2013	2014	2015	2016 (1st half year)
Natural gas in a liquid or gaseous state, *including:*	42 404.8	43 437.8	45 506.5	26 840.2
1. Natural gas in a gaseous state *(internal use + exports), including:*	20 564.9	21 278.5	21 493.7	11 964.8
Natural gas in a gaseous state *(marketable gas)*	11 273.2	11 697.7	12 008.4	7 242.1
2. Associated petroleum gas (excluding oil gas obtained in the distillation of oil)	21 679.1	21 898.3	23 761.8	14 727.4
3. Liquefied natural gas	160.8	261.0	251.0	148.0

Source: MNE (2016).

Almost 90% of the natural gas in a gaseous state was produced in the West Kazakhstan region, 6% in the Mangistau region, 1.8% in the East Kazakhstan region, and 1.4% in the Zhambyl region.

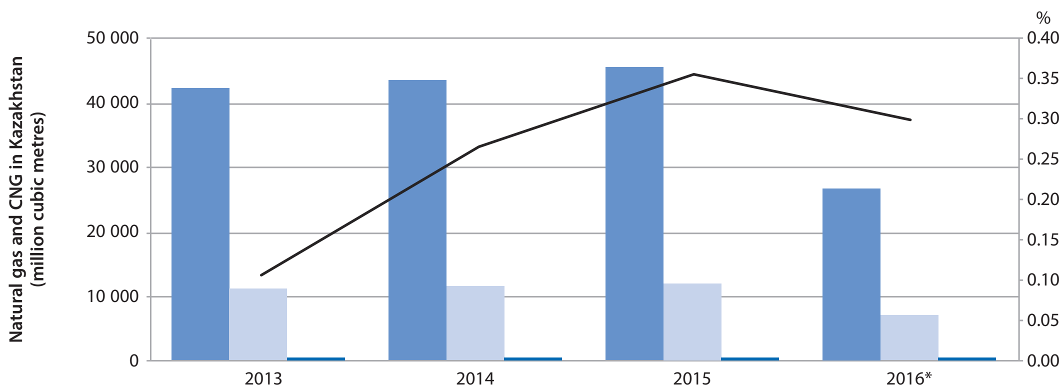
According to the Concept of Development of the Gas Sector till 2030, in 2013, almost half of domestic consumption, 45.2%, is by energy production organisations, 25.5% by industry, and 29.3% by population and municipal enterprises. The use of commercial gas for transport has been increasing (GoK, 2014).

CNG production is carried out directly at CNG stations from network natural gas, and the production capacity is fully used. In 2015, about 42.8 mln m^3 of CNG was produced in Kazakhstan. Of this amount, 65% was produced and consumed in Almaty, 21% in Shymkent, 7.5% in Kyzylorda, 3.7% in Taraz, 1.4% in Uralsk and 0.9% in Rudnyi. According to information provided to the OECD from KazTransGaz Onimderi LLP, CNG is not imported.

Figure 5.1 shows the relation between total production of natural gas in Kazakhstan – including both gaseous and liquid forms of natural gas (CNG/LNG) as well as its by-products (LPG) – and CNG consumption on the domestic market (which equals total

CNG production, as all CNG produced is consumed domestically). Based on the data for the first half of 2016, it can be expected that the production of natural gas and CNG will exceed the previous year.

Figure 5.1. **Relation between production of natural gas and CNG in Kazakhstan**



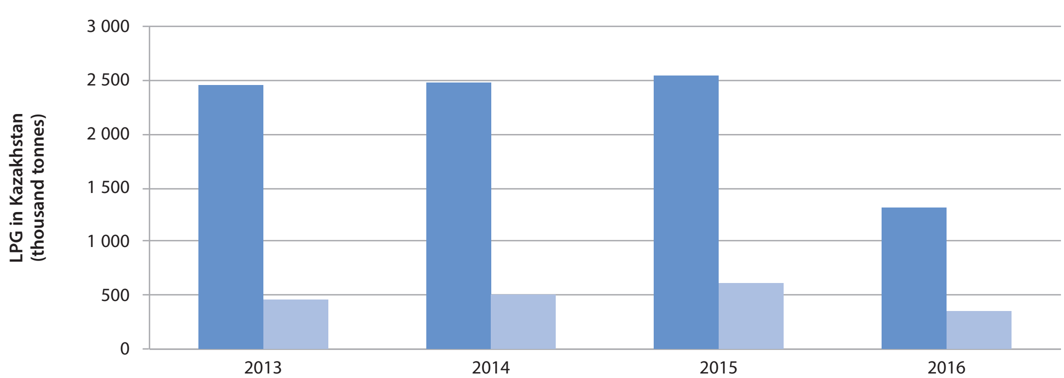
	2013	2014	2015	2016*
Natural gas production (1)	42 404.8	43 437.8	45 506.5	26 840.2
Marketable gas (1)	11 273.2	11 697.7	12 008.4	7 242.1
CNG production (1)	11.80	31.10	42.80	21.70
CNG as % of marketable gas (2)	0.10	0.27	0.36	0.30

Source: Data provided by KazTransGaz Onimderi LLP to the Ministry of Energy of Kazakhstan.

* First half of 2016.

According to data provided to the OECD by the Gas Industry Development Department of the Ministry of Energy, the production of liquefied petroleum gas for the years 2013-16 showed a slight upward trend (Figure 5.2). LPG production in 2015 amounted to 2.53 mln tonnes. The largest percentage of LPG production is from the Atyrau (51%), Aktobe (15%) and Pavlodar (10%) regions.

Figure 5.2. **Production and consumption of liquefied petroleum gas in Kazakhstan**



	2013	2014	2015	2016
Production	2 448.2	2 464.1	2 535.5	1 315.3
Consumption	464.6	495.7	605.6	346.3

Source: Data provided by KazTransGaz Onimderi LLP to the Ministry of Energy of Kazakhstan.

Note: 2016 data cover only the first six months of 2016.

Of the total volume of LPG produced in 2015, only about a quarter was consumed domestically – 6.06 mln tonnes or 23.9% of total LPG production. It is noteworthy, however, that the share of domestic LPG consumption is growing, increasing from 19% in 2013 to 26.3% in 2016, based on the results of the first six months. In 2015, the main regions consuming LPG were: Mangistau (26.8% of total consumption), South Kazakhstan (11.5%), Almaty (11.4%) and Karaganda (7.6%).

No statistics are maintained on the consumption of LPG by type of use. According to unofficial information from the Department of Gas Industry Development of the Ministry of Energy, LPG consumption as a motor vehicle fuel accounts for about half of total consumption (i.e. an average of about 250 000 tonnes/year).

At the same time, according to the Concept for the Development of the Gas Sector till 2030 (GoK, 2014), more than 48% of total domestic LPG consumption goes to public and municipal enterprises and 42% to industrial enterprises. The share for transport is estimated at 9% of total domestic consumption (an average of about 50 000 tonnes).

The LPG that is not used for domestic consumption is exported. The share of LPG exports amounted to 76% of production in 2015. LPG imports, on the other hand, are not significant and constitute less than 1% of total production.

Fuel prices

According to Article 7-1 of the Law on Natural Monopolies (PoK, 1998), state regulation of prices also applies to the gas market (effective until 1 January 2017), and with the specifications established by the Law on Gas and Gas Supply (PoK, 2012), includes the following services: wholesale and (or) retail sale of liquefied petroleum gas; retail sale of liquefied petroleum gas for fuelling motor vehicles; wholesale and (or) retail sale of marketable gas.

According to data provided to the OECD by the JSC Information-Analytical Centre for Oil and Gas of the Ministry of Energy, the average retail price (including a 12% value-added tax, or VAT, on liquefied petroleum gas in 2016 was KZT 85.2 per kg [USD 0.25 per kg]). The price varies depending on the region, from KZT 25.3 per kg (USD 0.07 per kg) in the Aktobe region to KZT 135 per kg (USD 0.39 per kg) in Almaty.

The average retail price (including a 12% VAT) for LPG used as a vehicle fuel is KZT 50 per litre[2] (USD 0.15) and for CNG – KZT 57.6 per 1 m^3 (USD 0.17). The prices vary across regions.

In 2016, the average retail price (including a 12% VAT) for a litre of petrol AI-92 was KZT 124 (USD 0.36), and the price per litre of summer and winter diesel fuel was KZT 98 and KZT 152 (USD 0.28 and USD 0.44), respectively. The average cost of diesel fuel is the same as that of petrol.

The analysis of prices for different fuel types shows that the prices of CNG and LPG are nearly 2.5 times less than the price of traditional fuels (petrol, diesel).

In addition, petrol and diesel fuels are subject to excise tax, while CNG and LPG are not (Table 5.2). Table 5.3 contains information on the average producer prices of fuels, net of tax.

Table 5.2. **Excise tax rates on petrol and diesel fuel**

No.		Excise tax rates for 1 tonne (in KZT)	
		Petrol (except for aviation)	Diesel
1.	Wholesale by manufacturers of petrol (except for aviation fuel) and diesel fuel of own production (April-October)	10 500	9 300
2.	Wholesale by manufacturers of petrol (except for aviation fuel) and diesel fuel of own production (November-March)	10 500	540
3.	Wholesale by individuals and legal entities of petrol (except for aviation fuel) and diesel fuel	0	0
4.	Retail sales by manufacturers of petrol (except for aviation fuel) and diesel fuel of own production (April-October)	11 000	9 360
5.	Retail sales of petrol by manufacturers (except for aviation fuel) and diesel fuel of own production (November-March)	11 000	600
6.	Retail sales by individual and legal persons of petrol (except for aviation fuel) and diesel fuel of own production	500	60
7.	Import	4 500	540

Source: GoK (2015b).

Table 5.3. **Average fuel producer price, net of VAT and excise tax**

Fuel type	Unit	2013	2014	2015	2016
Diesel fuel [a]	KZT/tonne	103 999	97 192	86 146	85 106
Petrol, including aviation fuel [b]	KZT/tonne	96 200	99 888	98 458	-
Petrol (distillation temperature – 30-220°C) for engines with spark ignition, with a lead content of not more than 0.013 g/l, with no additives or tetraethyl lead and tetra methyl lead (TEL TML)	KZT/tonne	96 249	100 068	98 580	111 220
Natural gas [c]	KZT/thous. m^3	5 258	4 640	4 956	5 426
Aktobe	KZT/thous. m^3	7 094	-	-	-
West Kazakhstan	KZT/thous. m^3	3 405	-	-	-
Zhambyl	KZT/thous. m^3	12 510	-	-	-
Mangistau	KZT/thous. m^3	7 720	-	-	-
Liquefied petroleum gas (propane-butane) [d]	KZT/tonne	79 096	115 792	63 811	35 069

Source: Based on data provided to the OECD by the Committee of Statistics of the Ministry of National Economy of Kazakhstan.

Notes: a. Arithmetical average.
b. Geometrical average.
c. For LPG, only information on propane-butane is available.
d. CNG is produced directly from natural gas, using compressors at filling stations.

Finally, Table 5.4 contains information on the average retail price of various fuels.

Table 5.4. **Average retail price of various fuels**

Fuel type		Unit	2013	2014	2015	2016	Source
Petrol	Petrol AI-80	KZT/litre	88	89	88	89	1
	Petrol AI-92	KZT/litre	111	119	111	124	1
	Petrol AI-95, 96	KZT/litre	141	149	138	139	1
	Petrol AI-98	KZT/litre	161	165	155	155	1
Diesel fuel	Diesel fuel	KZT/litre	105	-	-	-	1
	Winter diesel fuel	KZT/litre	-	155	149	152	1
	Summer diesel fuel	KZT/litre	-	110	97	98	1
Natural gas	Gas (natural)[a]	KZT/m^3	11	13	14	15	1
	CNG	KZT/m^3	50	53	56	58	2
Liquefied gas	Gas (liquefied)[a]	KZT/kg	131	142	132	133	1
	Gas liquefied[a] (in balloons)	KZT/balloon (=50 l)	2 602	2 607	2 172	2 096	1
	LPG	KZT/kg	116	110	89	85	3
	LPG on filling stations (estimate)	KZT/litre				51	4

Sources: Based on data provided to the OECD by **1.** Committee of Statistics of the Ministry of National Economy of Kazakhstan; **2.** KazTransGaz Onimderi LLP; **3.** Information-Analytical Centre for Oil and Gas of the Ministry of Energy of Kazakhstan; **4.** Estimate based on retail prices of dominant enterprises in the retail sale of LPG for motor vehicles (data obtained from the website of the Committee for Regulation of Natural Monopolies and Protection of Competition).

Note: a. Gas transported through distribution networks.

Conclusions for the CPT Programme

Using CNG and LPG to power public transport buses will decrease operating costs, given the lower costs of these fuels compared to diesel. Improved diesel fuel, however, such as Euro V and VI can also be viable alternatives where CNG and LPG are not available.

Production and import of buses

City buses in Kazakhstan are produced in the following areas:

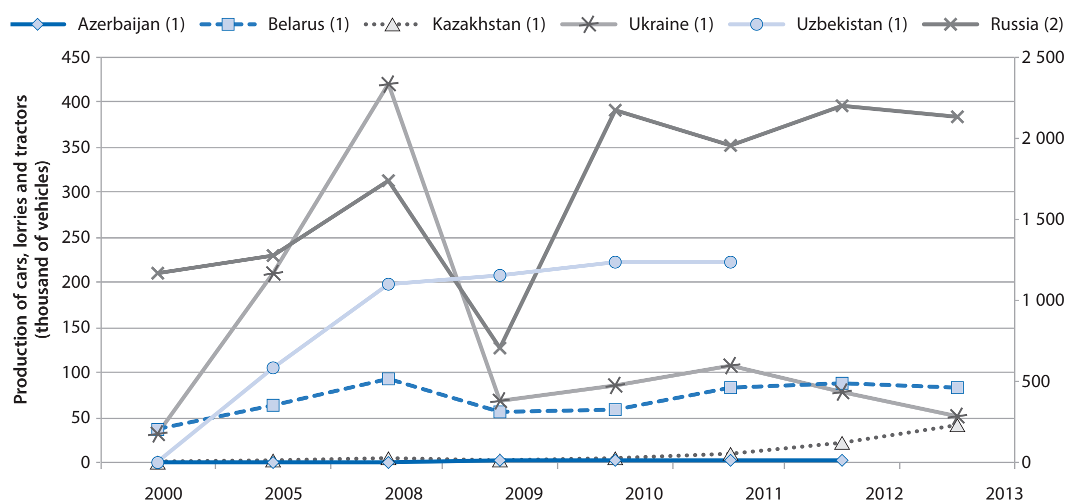
- Kostanay oblast: IVECO buses by Saryarka AvtoProm, LLP;
- East Kazakhstan oblast: Daewoo buses by Daewoo Bus Kazakhstan, LLP;
- Almaty: Hyundai buses by Hyundai Auto Truck & Bus, LLP.

According to data provided to the OECD by the Committee of Statistics of the Ministry of National Economy, a total of 295 vehicles[3] for transport of 10 or more people were produced in 2015. On the other hand, according to data from the Ministry of Investments and Development, the production of passenger buses in 2015 was 225 in total, of which 7 buses produced by Daewoo Bus Kazakhstan had a CNG engine. Daewoo Bus Kazakhstan reported that in 2016 it had produced 35 CNG-powered buses. To date, buses running on CNG have not been produced in the other two domestic companies.

The Belgian company VanHool Engineering is planning to establish a bus production facility in the Kyzylorda region. VanHool and Kazakhstan's Baikonur SEC (Kyzylorda Oblast) have agreed to co-operate, and mutual financing has been provided for the project, whose total cost is estimated at USD 11 mln. Initially, Kazakhstan's content can make up to a quarter of total production. There is a plan to manufacture buses that will run on electricity for use as transit shuttles to transport tourists from the Astana airport to the EXPO-2017 venue (KazPravda, 18 June 2016 and Vremya Vostoka, 20 June 2016).

In 2010, the Association of Kazakhstan's Car Business (AKCB) began operations. A non-profit professional association of official dealers, importers, distributors and national manufacturers of the automobile market in Kazakhstan, one of the aims of the association is to promote the development of the domestic automobile industry. As can be seen in Figure 5.3, the output of the automotive sector in Kazakhstan has experienced a significant increase since 2010. Although bus production is not included in this chart, local bus producers can benefit from the development of the automotive sector in Kazakhstan as such (e.g. when more suppliers of car parts enter the market.)

Figure 5.3. **Production of cars, trucks and tractors in selected EECCA countries, 2000-13**



Source: CIS (2014).

Domestic market prices

According to information provided to the OECD by Saryarka AvtoProm, LLP, the normal production of ANKAI buses is scheduled to begin in 2017. Initial production of buses is currently undergoing certification. The estimated purchase price of these buses is:

- CNG ANKAI HFF6101GK39C: KZT 39.3 mln (USD 116 000);
- Diesel ANKAI HFF6101GK39: KZT 34 mln (USD 100 000).

According to information provided to the OECD by domestic bus manufacturers, the average domestic price of a large-class city bus with a Euro IV diesel engine is KZT 38.3 mln (USD 112 000) at current exchange rates. A CNG-powered model, on the other hand, was KZT 46.2 mln (USD 135 000). In other words, the average price difference, depending on the type of engine, was KZT 7.99 mln (USD 23 000).

Table 5.5 shows the actual prices of buses purchased in Kazakhstan in the past two years and reveals a distinct price advantage for domestically produced diesel and CNG models.

Table 5.5. **Actual purchase price of buses**

No.	City	Year of purchase	Model of bus	Country of origin	Engine type (diesel, CNG, LPG)	Price per unit, KZT	Units purchased	Note
1	Kyzylorda	2015	Zhongtong LCK6105hgc Class-M3	China	CNG	61 867 800	10	Public procurement
2	Kyzylorda	2016	Zhongtong LCK6105hgc Class-M3	China	CNG	61 867 800	82	Public procurement
3	Almaty	2015	Isuzu	Uzbekistan	Diesel	28 067 000	15	Purchased directly by private carrier (not a public procurement)
4	Almaty	2015	Hyundai County (microbus)	Korea	Diesel	11 149 600	15	Purchased directly by private carrier (not a public procurement)
5	Almaty	2015	Daewoo	Kazakhstan	Diesel	17 085 000	5	Purchased directly by private carrier (not a public procurement)
6	Almaty	2016	Hyundai County (microbus)	Korea	Diesel	11 149 600	5	Purchased directly by private carrier (not a public procurement)
7	Almaty	2016	Yutong	China	CNG	27 802 900	100	Purchased directly by private carrier (not a public procurement)
8	Almaty	2016	Daewoo	Kazakhstan	CNG	35 314 583	35	Purchased directly by private carrier (not a public procurement)
9	Almaty	2016	Daewoo	Kazakhstan	CNG	37 000 000	2	Purchased directly by private carrier (not a public procurement)
10	Zhanaozen (Aktau region)	2015	GAZ 322133 II-Class (microbus)	Russia	Petrol/LPG	3 500 000	4	Purchased directly by private carrier (not a public procurement)
					Average price, CNG-fuelled bus	44 770 617		
					Average price, diesel-fuelled bus	16 862 800		
					Average price, LPG-fuelled bus	3 500 000		

Source: Data collected by OECD from Oblast (region) and city Akimats.

Bus imports

The analysis of bus imports showed that in 2015 a total of 1 630 passenger buses were imported, 1 419 of which were new and 204 used. By engine type, 331 buses were diesel, 1 292 were spark ignition engines (petrol or gas) and 7 other types of engines.

The import of goods to Kazakhstan is regulated under the Commodity Classification for Foreign Economic Activity (CCFEA) of the Customs Union. This classification according to CCFEA allows to classify buses as new and used, by engine type (diesel engine or engine with spark ignition), but does not distinguish whether buses' engines work on gas or on petrol. Separating imported buses by their environmental class is not possible.

Analysis of imports into Kazakhstan showed that the import price for a new bus on average for the first half of 2016 was USD 113 000, as compared with USD 82 946 per unit in 2015.

Conclusions for the CPT Programme

Domestic production of CNG and diesel-powered buses represent a distinct purchase cost advantage and should be encouraged as a way to replace the outdated and depreciated domestic bus fleet.

The following unit prices should be used as assumptions in the design of the CPT Programme:

- CNG bus (domestically assembled): KZT 46 mln (USD 134 000); discounted for large orders: KZT 35 mln (USD 103 000);
- CNG bus (imported): KZT 33 mln to KZT 62 mln (USD 96 000-181 000); discounted for large orders: KZT 23-30 mln (USD 67 000-88 000);
- LPG bus: KZT 42 mln (USD 122 000); discounted for large orders: KZT 32 mln (USD 94 000);
- Diesel bus (Euro V or VI): KZT 38 mln (USD 111 000); discounted for large orders: KZT 20 mln (USD 58 000).

Public transport fares

The following fare rates for single rides apply in the pilot cities and serve as an approximation of the fare schedules in other cities.

- Kostanay city (Akimat of Kostanay, 2013):
  - Standard: KZT 60 (USD 0.17);
  - Children up to 7 years: free of charge; 7-15 years: half fare, KZT 30 (USD 0.09);
  - Retired people: KZT 50 (USD 0.16);
  - Visually impaired (first and second disability groups) and veterans of World War II: free of charge.
- Shymkent city (Akimat of Shymkent, 2016):
  - Standard: KZT 70 (USD 0.2);
  - Children up to 7 years: free of charge; 7-15 years: KZT 30 (USD 0.09);
  - Retired: KZT 70 (USD 0.2).

Available co-financing for investment projects

This section reviews possible mechanisms that could potentially be used to co-finance investment projects from the budget (including types of eligible beneficiaries) and other domestic sources, including the investment programme discussed in this analysis. Based on a review of the national legislation, there are four groups of possible mechanisms to co-finance investment projects in the transport sector:

- as part of the implementation of public investment projects;
- within the framework of a subsidy programme for socially significant types of transport;
- within the framework of private entrepreneurship support measures; and
- other sources of funding.

These sources are reviewed in turn below.

Public investment projects

These are usually projects of local importance as the recipients of the economic benefits are from a region, city of republican significance, or the capital. One of the conditions for the implementation of a project as a public one is its inclusion in one of the public budget programmes. According to the Budget Code of the Republic of Kazakhstan (PoK, 2008), public investments programmmes (PIP) come under two types: budget investment (through the formation or increase of the authorised capital of a company), and public-private partnership projects.

Budget investments

Budget investments through the formation or increase of the authorised capital of a company (Article 159 of the Budget Code, PoK 2008) – in other words state equity in the authorised capital of a municipally-owned company or legal entity – are carried out by the Government of Kazakhstan and local executive bodies in the manner set out by law. Possible recipients include municipal companies providing transport services, and the source of funding includes republican and/or local budgets.

Public-private partnership

A public-private partnership (PPP) may be established in all sectors (industries) of the economy, typically for the delivery of a public service. According to the Law on Public-Private Partnership, if the object of the public-private partnership project is reimbursed for investment expenditures, the PPP object has to be transferred to public ownership. Possible recipients include private service companies (PoK, 2015).

Subsidy programme for socially significant types of transport

The Law on Automobile Transport provides for subsidies by local executive bodies of the losses of providers of socially significant types of passenger transport, if the fares established by the local government for such services do not ensure profitability (PoK, 2013).

The Order of the Ministry of Investments and Development approved the Rules of Subsidy from Budget Funds, the Losses of Carriers Related to the Implementation of Socially Significant Types of Passenger Transport (MID, 2015).

Socially-significant types of transport are passenger transport vehicles in regular service that have an impact on the socio-economic situation of the public and are organised to ensure an affordable level of fares and the possibility of free movement of the population on the territory of Kazakhstan. The list of socially significant road links that can be subsidised for a three-year period is prepared by the local government of the respective administrative-territorial unit.

Losses from the provision of transport services are defined as the difference between the tariff for passenger transport, defined in accordance with the Methodology for Calculating Tariffs for the Provision of Services in Passenger and Luggage Transport on Regular Routes (hereinafter Methodology) and the tariffs for socially significant road links, established by the local executive bodies (MTC, 2011).

The tariff, calculated in accordance with the Methodology, includes operating costs for fuel, lubricants, repair and maintenance of buses, and wages. It also provides for depreciation of buses and a required level of profitability.

Potential beneficiaries are carrier companies servicing socially significant routes.[4]

Private entrepreneurship support measures

State support measures also exist for private companies. The Resolution of the Government of the Republic of Kazakhstan approved the Unified Business Support and Development Programme Business Road Map 2020 (BRM), whose purpose is to ensure sustainable and balanced growth of regional businesses, as well as to support existing workplaces and the creation of permanent new ones (GoK, 2015a). The framework of the BRM Programme provides for the following measures of financial support to private companies:

- interest rate subsidies on loans/finance leasing contracts of banks/development bank/leasing companies (operator: Zhasyl Damu EDF, JSC);[5]
- partial guarantees of bank loans/development bank (operator: Zhasyl Damu EDF, JSC);
- provision of state grants (operator: Zhasyl Damu EDF, JSC);
- long-term lease financing (BRK Leasing JSC);
- development of production (industrial) infrastructure (allocation of funds from the national budget).

The National Management Holding Baiterek JSC manages the partnership shares of the companies listed above, as well as other national development institutions, national companies and other legal entities.

Interest rate subsidies

This financial support involves partial reimbursement of expenses paid by an entrepreneur to a bank, micro-financial organisation or leasing company, in exchange for satisfying certain conditions in the future, related to the entrepreneur's operating activities. The size of the subsidy depends on the sector and city where the project is taking place:

- 7% for projects in priority sectors of the economy;
- 10% for projects without any sectoral restrictions in single-industry towns, small towns and rural areas;
- 10% for projects in priority sectors of the manufacturing industry;
- 4% and 5% for foreign currency/KZT-denominated bank loans.

The interest rate on a loan is not more than 19% per annum for a second-tier bank and no more than 13% for a development bank. The subsidy on the loan/leasing transaction is provided for a period of three years, with the possibility of an extension of up to six years.

This form of support is used for new investment projects; for working capital financing, but for no more than 30% of the loan amount; for the acquisition and/or modernisation of fixed assets and/or production expansion.

Loan guarantees

A loan guarantee is the form of state support for entrepreneurs, used to provide a partial guarantee as collateral for loans to entrepreneurs, under the terms of the BRM Programme and in accordance with the contract of guarantee. Potential beneficiaries include the priority sectors identified in the BRM-2020 and priority sectors of the manufacturing industry in the framework of the State Programme of Industrial-Innovative Development of Kazakhstan for 2015-19 (EO PoK, 2014). There are no sectoral restrictions for young, first-time entrepreneurs, or for those in rural areas and in single-industry towns and small towns. For such applicants, all sectors are eligible.

An entrepreneur may submit an application for a loan guarantee of up to KZT 180 mln (USD 52 000). The guarantees for first-time entrepreneurs/first-time young entrepreneurs are up to 80% of the total loan amount; and for existing entrepreneurs, up to 50%.

The interest rate on a loan is capped at no more than 19% per annum for a second-tier bank and no more than 13% for a development bank. Financing of partial guarantees on loans extended by commercial banks or development banks is provided by the national budget through targeted transfers to the regional co-ordinators of the BRM Programme.

Grants

Grants are provided to small businesses to underwrite new business ideas in the priority sectors of the economy and manufacturing industries within the BRM-2020, including:

- first-time young entrepreneurs;
- first-time entrepreneurs;
- women, people with disabilities and people older than 50 years;
- in single-industry towns, small towns and rural areas, with no sectoral restrictions.

The maximum amount of a grant per entrepreneur is KZT 3 mln (USD 9 000). Grants are allocated for the purchase of fixed assets and materials, purchase of technology, acquisition of intangible assets and acquisition of the rights to a franchise.

Long-term leasing financing

Entrepreneurs implementing and/or planning to implement investment projects in priority sectors of the economy, including transport, under the State Programme of Industrial-Innovative Development of Kazakhstan for 2015-19 (EO PoK, 2014) can benefit from this type of support. The conditions are as follows:

- the entrepreneur’s contribution must be at least 15% of the total cost of the leased assets;

- the cost of the leased asset must be no less than KZT 150 mln (USD 44 000), and for the consumer goods industry, no less than KZT 75 mln (USD 22 000);
- the term must be up to 10 years;
- the interest rate must be 5%;
- labour productivity: The beneficiary of the long-term lease financing commits to increase labour productivity in accordance with the Agreement on the Monitoring of Industrial-Innovative projects.[6]

Development of production (industrial) infrastructure

The development of production (industrial) infrastructure means the creation of missing infrastructure for small and medium-sized enterprise (SME) projects aimed at the creation of new manufacturing sites, as well as the modernisation and expansion of existing ones. In this case, the allocation of funds is carried out in accordance with the budget legislation of the Republic of Kazakhstan. Beneficiaries include:

- entrepreneurs operating in priority sectors of the economy and manufacturing industries, defined by the State Programme of Industrial-Innovative Development of Kazakhstan for 2015-19 (EO PoK, 2014), and Business Road Map 2020 (GoK, 2015a);
- entrepreneurs from single-industry towns, small towns and rural areas.

The allocated funds are directed to the construction and reconstruction of the following infrastructure: drainage, water supply (drilling wells for water supply), gasification, water mains, steam pipelines, heating boilers for industrial sites, water supply systems, railway sidings, railway lines, telephones, electrical power substations, transmission lines, septic tanks, combined-cycle gas turbines, and alternative energy sources. In this instance, creation of transport infrastructure does not meet the criteria for the provision of support measures.

In addition to these instruments of financial support, SMEs may apply for preferential loans, depending on the programmes offered by various development institutions. For instance, Zhasyl Damu EDF, JSC offers SMEs participation in different programmes of conditional placement of funds of the Zhasyl Damu EDF, JSC in second-tier banks and other organisations for on-lending activities to entrepreneurs on preferential terms.

Other sources of financing

Other sources of co-financing for such projects can be non-governmental organisations (NGOs) assigned to perform such tasks, as well as other state grants and awards not so far mentioned. The funding of state grants and awards is covered from budgetary funds. For example, the Social Development Foundation Samruk-Kazyna Trust, with the assistance of government agencies and ministries, develops charitable projects to resolve current socially significant issues and can be considered as a potential source.

Conclusions for the CPT Programme

As detailed in the Market Study, private entities commonly provide public transport services in large cities. This provides an opportunity to tailor co-financing from the CPT Programme in order to provide incentives for investments to replace outdated bus fleets.

Given that the cost of CNG and LPG-powered buses is higher than new model diesel-powered buses, the programme should provide the amount of assistance necessary for the project to become profitable. This is defined as the point at which the net present value (NPV) of the investment is equal to zero from the point of view of the investing entity (see Annex B). This approach provides an opportunity for direct assistance to the service provider or an operator involved in a public-private partnership arrangement, as noted in the chapter on institutional solutions (see Chapter 6).

In examining domestic production of buses, the market analysis found that domestic production of CNG and diesel-powered buses represent a distinct purchase cost advantage and should be encouraged as a way to replace the outdated and depreciated domestic bus fleet. Based on the market analysis, various options for replacement of the public transport fleet were analysed. Since the Republic of Kazakhstan has abundant natural gas reserves, CNG appears to be the best fuel type. Other solutions, such as trams, were not included in the programme pipeline, because the networks are too small or non-existent except in Almaty and Astana.

Notes

1. Natural gas with impurities removed and suitable for sale on the market.
2. This average price is calculated based on the prices of the regulated market entities with a dominant (monopolistic) position on the retail sale of liquefied petroleum gas for vehicle re-fuelling, specified on the website of the Committee on Regulation of Natural Monopolies and Protection of Competition of the Ministry of National Economy (see www.kremzk.gov.kz/eng/).
3. See http://stat.gov.kz/getImg?id=ESTAT137924.
4. Under the Budget Code (PoK, 2008), budgetary subsidies are irrevocable payments from the budget to individuals and legal entities, including owner-operated farms or farming enterprises, solely when no other option is available to provide public functions and to implement the socio-economic development goals of the country or region, in cases provided for by legislative acts of the Republic of Kazakhstan. Possible recipients include private carrier companies
5. The mission of the Zhasyl Damu Fund is to contribute to the qualitative development of SMEs in Kazakhstan through comprehensive support, including a wide range of financial instruments, and to develop competence programmes. The plan is to make the Fund an effective national institution carrying out state policy to support and develop small and medium-sized businesses.
6. After signing a financial leasing contract between JSC "BRK-Leasing" and the entrepreneur, an agreement on the monitoring of the industrial innovative project is signed between the JSC Kazakhstan Industry Development Institute, BRK-Leasing and the entrepreneur. The standard form of agreement on the monitoring of industrial and innovative projects is approved by the authorised body in the sphere of state support of industrial-innovative activity. See GoK (2015a).

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Chapter 6

Institutional arrangements for implementing the programme

This chapter discusses issues related to the institutional arrangements that can be set up to manage the clean Public Transport Investment Programme. It suggests a three-level institutional structure which comprises: i) *a programming entity,* ii) *an implementation unit and* iii) *a technical support unit. The chapter also suggests a possible division of responsibilities across these three entities, and describes the minimum operating regulations required to adequately manage the programme.*

Institutional arrangements to manage a public investment programme

A number of different institutional forms can be established to manage public environmental expenditure. Simple expenditure programmes (e.g. financing research or education, purchasing simple equipment or standard services) may be managed directly by assigning additional responsibilities to existing government institutions at different levels, using their regular staff and routine budget processes. For larger-scale, specialised programmes, especially for programmes that involve the financing of capital investments, special institutional arrangements are recommended. These special arrangements may take many institutional forms and involve various types of implementing units (OECD, 2007).

Deciding which form is most appropriate will generally depend on a variety of factors related to the sources of finance, the types of disbursements envisaged, and the legal and political culture of governance in a given country. Regardless of the institutional form, public environmental expenditure management should involve institutional structures and procedures that promote environmental effectiveness, embody fiscal prudence, and efficiently utilise financial and human resources.

Experience shows that these arrangements can take three basic institutional forms:

1. governmental implementation units;
2. environmental funds or a similar public finance institution; and
3. directed credit or a line of credit at financial intermediaries.

Governmental implementation units mainly manage government budget resources; although one of these institutional forms, project implementation units, may also manage multilateral or bilateral grant resources. Governmental implementation units include the following institutional forms:

- government departments with responsibility for procuring goods and services or financing specific projects within the state budget;
- project implementation units established in a government department to implement projects, within a specific government expenditure programme included in the budget;
- autonomous/decentralised government units financed by the budget but created to decouple the delivery of services or administrative tasks from policy formulation.

Regardless of the type of governmental implementation unit chosen, carrying a programme to completion requires capacity for project selection, implementation and monitoring. This means hiring skilled, trained personnel with a dedicated focus on the programme. Environmental programmes of EUR 50 mln (USD 55 mln) annually and about 200 contracts per year, implemented in Central and Eastern Europe generally need staff of more than 20 people. In the case of the programme discussed in this study, given the relatively small number of contracts and homogenous types of investments required, only 5 people will be needed.

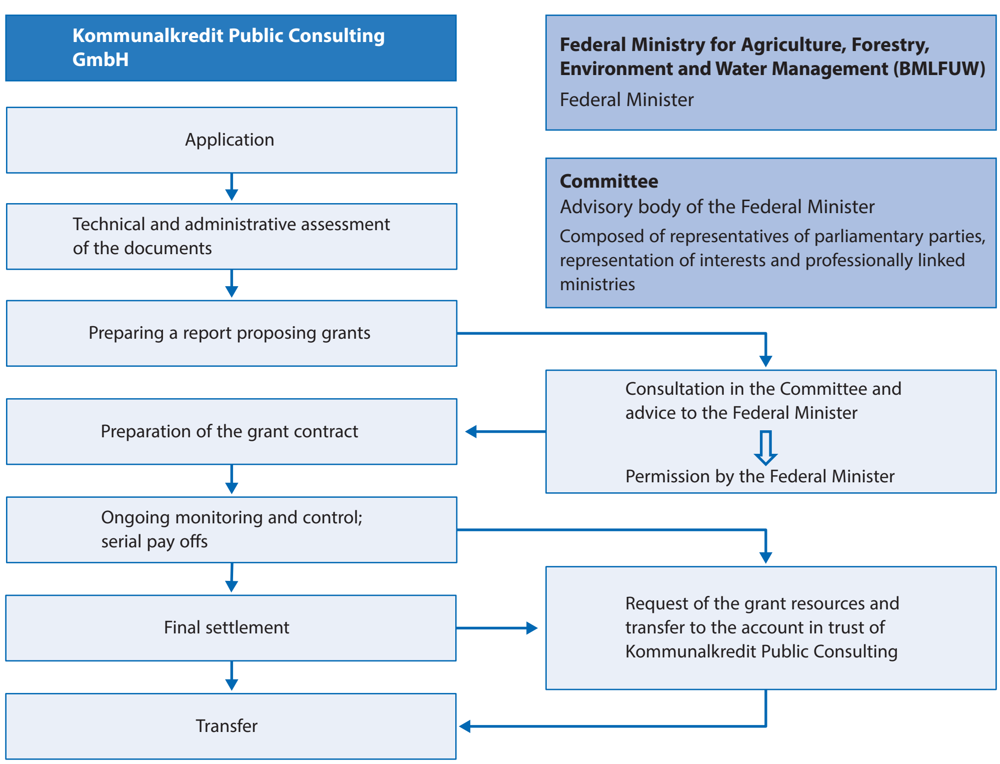
In most instances, the institutional arrangement for bigger (investment) programmes includes both a management (implementation) unit and a supervisory body. The implementation unit's management and staff are responsible for the day-to-day project cycle activities (identification, selection, appraisal and monitoring of projects), development of the annual expenditure plan and budget, monitoring and preparation of reports. The supervisory body usually focuses on undertaking strategic decisions, approving internal operating procedures and rules (including eligibility and appraisal criteria to guide project selection). This division of responsibilities provides a system of checks and balances and improves the accountability of the programme. The supervisory body retains final decision-making authority to approve financing of the individual projects recommended by the implementation unit's technical staff after the appraisal process.

Outsourcing or contracting out allows an implementation unit to enter into a contract with an outside supplier for the provision of goods and services typically provided internally. If this option is chosen, good practice requires that outsourcing be conducted through competitive tendering.

To take one such example, the Austrian Ministry of Environment has delegated the management of the grant schemes for Austria's Environmental and Water Management Fund to a private consulting company, Kommunalkredit Public Consulting (KPC) GmbH since 1993. KPC is also responsible for the Austrian Joint Implementation (JI)/Clean Development Mechanism (CDM) programme and serves as one of the four managers of the newly established Climate and Energy Fund. Annually, KPC manages more than 3 000 projects. Its role is to advise the Ministry during the programme development phase and on the development of support programmes, as well as to provide technical, economic and legal assessment of support and consultancy projects. KPC also advises the decision-making bodies of these institutions on the drafting of contracts, monitoring of project implementation and management of disbursements. Significantly, when the management of Environmental and Water Management Fund was outsourced to KPC in 1993, its administrative costs were immediately reduced by more than half and have fallen since 2000 to only 20% of the 1993 cost.

Figure 6.1 presents the management scheme for the Austrian JI/CDM programme.

Figure 6.1. **Management scheme for the Austrian JI/CDM programme**



Source: Provided to the OECD by Kommunalkredit Public Consulting.

Proposal for CPT Programme institutional set-up

The institutional set-up needs to ensure that sufficient resources are allocated to meet the programme's objectives, and that qualified staff and instruments to implement the programme be made available. In general, programming and project appraisal should be strictly separated. Programming is the responsibility of the programming entity in the government agency with oversight on management of the investment programme. Project appraisal is a technical process conducted by competent technical staff recruited on a competitive merit basis and held responsible for their decisions. The implementation unit should be operationally and technically independent and shielded from political pressures by rules and procedures developed by the programme's technical staff.

The institutional set-up proposed here includes three levels: *i)* programming entity, *ii)* implementation unit and *iii)* a technical support unit. Their roles and responsibilities are presented in detail below.

Programming entity

The programming entity (PE) is responsible for the design of the programme, including the following tasks (adapted from OECD, 2007):

- Define priority environmental objectives for the investment programme that are specific, measurable, realistic and time-bound.
- Develop an investment programme that responds to the overall environmental and climate-related objectives. This programme includes specific targets, cost estimates, description of eligible project types and beneficiaries, terms of financing, procedures, principles and criteria of project appraisal and selection, procurement rules, programme timeframe and indicators of performance.
- Determine sources of funds and the size of the financial envelope of the investment programme.
- Select the best institutional arrangement for managing the investment programme, in particular whether the programme may be managed directly by assigning additional responsibilities to existing government institutions at different levels or whether special institutional arrangements are required to help implement the programme.
- Select, contract and monitor the implementation unit to manage the investment programme.
- Select and monitor the technical support units required to implement the programme.

The Ministry of Energy can perform the role of the programming entity. The programming entity will use its available staff and resources to undertake its programming duties in consultation with relevant bodies. In performing its duties, the programming entity will consult with other relevant government agencies, professional associations, local municipalities and non-government organisations as appropriate. In addition, representatives of these bodies may be invited to sit on and have an advisory role in the supervisory board of the programme.

Implementation unit

The implementation unit (IU) is charged with the drafting of the programme's operating regulations, as described in the section below. The IU needs to consult with the technical support unit(s) in the drafting and use of its operating regulations. An institution similar to the Astana International Financial Center (AIFC) could be considered as a candidate for the

IU, to which the management of the programme could be outsourced.[1] Another potential IU is the Zhasyl Damu EDF, JSC[2] and, for the pilot phase, the Social Entrepreneurial Corporations[3] at the local level. The IU will also define the allocation of the programme budget for the given year (or programming cycle) into project types (project "baskets").

Technical support unit

The technical support unit (TSU) gives specialised assistance, advice and expertise in the areas of energy and fuel efficiency, CNG and LGP buses, modern diesel buses and air pollution and GHG emission reductions. For example, the Alliance of Legal Entities "Kazakhstan Association of High-tech Energy-Efficient and Innovation Companies" (ALE-KAHTEIK) (established with support by UNDP) could play this role. The Association of Kazakhstan's Car Business (AKCB), as a non-profit professional association of official dealers, importers, distributors and national manufacturers of the automobile market of Kazakhstan, could also be considered. Other TSUs may be defined, as deemed necessary and prudent.

Minimum elements for operating regulations

The effective implementation of the programme requires that the implementation unit (IU) define and publicise its operational rules and regulations. At a minimum, the core elements of such rules should include:

- definitions;
- general provisions;
- definition of eligible projects;
- rules for awarding grants;
- modification or termination of a grant contract;
- procedures for programme review.

Typically, the maximum level of a grant for a project should not exceed 50% of the funds earmarked for the applicable type of project in the approved IU's annual financial plan.[4] This is to leverage resources from other sources and ensure the commitment of the recipients to implementing the project using their own resources.

Under this particular programme, and given the nature of investments to be financed, the grant awarded by the implementation unit should not exceed:[5]

- 70% of investment costs for replacement of buses;
- 70% of investment costs for accompanying investments (such as dedicated bus lanes and CNG filling infrastructure).

The grant agreement should define in detail, at least, the following terms and conditions:

- amount of grant award (as an absolute value or as a share of total project investment cost);
- start and end dates of the project to be financed, as well as planned environmental effects;
- date on which the grant, or its instalments, will be transferred to the recipient;

- rights of the implementation unit to control the awarded grant as well as the method of securing possible return of the grant, if the project fails to meet its stated objectives;
- particular grantee's obligations arising under the contract with the programme implementation unit;
- conditions under which the contract loses its force;
- consequences of contract dissolution.

There are other procedural rules that need to be considered, for example:

- The grant may be transferred to the applicant all at once or in instalments (tranches).
- A portion of the grant may be transferred in advance at a level of up to 20% of the total value of the project, in cases when the lack of this advance transfer would render the project start-up impossible.
- The recipient that has received an advance on a grant is required to return to the IU any interest income resulting from holding the grant in its bank account (or the amount may be deducted from future tranches).
- The dates for making grant transfers are determined by the IU based on funds at its disposal and upon consideration of an applicant's proposal, as presented in the application.
- Financial resources from the grant are transferred exclusively for the purpose of meeting the payments required by the grantee. The recipient should allow the IU full access to original invoices prepared by contractors or suppliers.

The *OECD Handbook for Appraisal of Environmental Projects Financed from Public Funds* includes a detailed discussion of all relevant rules that need to be considered in defining the procedures for the programme implementation unit and could be useful in further defining procedural rules for the programme (OECD, 2007).

Programme promotion

Programme promotion is essential for the success of the programme. The promotion package might include the following elements:

- sending information to local administrations and distribution of the information to potential beneficiaries;
- distribution of the programme rules to local administrations and distribution of the information to potential beneficiaries;
- maintaining the IU's website with relevant information on rules for awarding grants and application forms;
- press information.

The costs of programme promotion should be included in the programme costs envelope.

Public private partnerships

Given the fact that the proposed programme involves public transport projects for replacing outdated buses with buses powered by cleaner fuels, and given that the projects will often generate operating cost savings, public-private partnerships (PPP) could be considered as a modality for project implementation.

A possible model would be to establish a company (a transport base company, but not a public transport operator) where a local government (local Akimat) and a private transport company both contribute equity (for example, the government would buy 49% of the company's shares and the private entity 51%). The PPP company purchases the new buses using this equity and the buses are then rented to the private transport company. The rental fee would be negligible or relatively small if the transport base company can provide some services, such as maintenance. The company may generate a small profit that in turn will be paid as a dividend to the owners.

If the PPP is to work, the interests of both parties need to be respected. For example, the Akimat's contribution to the equity could be paid back (through the purchase of shares by the private partner over time). Alternatively, the government could recoup some of its investment outlays from the company's dividends. According to interviews conducted by the project team, the purchase of buses could also be encouraged by imposing stricter limits on the age of buses or through national government or oblast subsidies for investment costs in the PPP company. These subsidies, if properly designed, could help avoid fare increases.

Lessons from similar experiences in other cities indicate that establishing a public transport PPP is a challenging exercise. It entails risks that may not always lead to an optimal solution. However, this does not necessarily preclude the success of the PPP model as such. For example, in one of the pilot cities, the Akimat of Shymkent and Green Bus Ltd. has already created a transport base company (with equity of 49% and 51%, respectively) (BNews KZ, 14 July 2016). Green Bus Ltd. serves nine routes in Shymkent. In addition, the Tolebi Sauda Company participates in a trilateral Memorandum with the Akimat and Green Bus, according to which Tolebi Sauda is to provide smooth gas-fuelling of 400 buses per shift. Such co-operation could be further developed to the mutual benefit of both parties. The establishment of any PPP scheme should begin with the identification and clear understanding of the implementation risks and the related consequences should be clearly assigned to each of the parties.

Need for complementary (non-institutional) policy action

Various regulatory barriers may complicate the implementation of even a well-designed investment programme. It is important that before a programme is developed and financed the government review the relevant regulatory basis and eliminate such barriers to the extent possible. Some of the key barriers directly affecting the implementation of the programme are presented below.

Addressing key regulatory barriers that can hamper programme implementation

Many of the policy and regulatory barriers identified by this study are comparable to challenges experienced in other countries. To ensure the programme's successful implementation, the government will need to:

- **Strengthen (diesel) engine emission norms and bring them closer to European standards.** Kazakhstan has still not yet developed modern emission norms for both passenger cars and heavy-duty truck and bus engines. The equivalent of the Euro IV emission standard, introduced in the European Union in 2005, has not yet been implemented. In 2014, Europe instituted the Euro VI standard. Promoting local production of clean engines would encourage the use of clean fuels.

- **Strengthen (diesel) fuel standards**: Modern diesel engine emission norms cannot be introduced if the available fuel does not meet certain standards. The engines include equipment sensitive to low-quality fuel, and SO_2 emissions directly depend on the fuel's sulphur content.
- **Strengthen technical inspection standards.** Although buses in Kazakhstan must pass technical inspections, these inspections are not strict on emissions. Bus owners thus have no incentive to improve emissions standards. Standards for technical inspection need to be better enforced.
- **Introduce adequate pricing signals.** Although CNG and LPG are cheaper than diesel, the CNG- and LPG-fuelled buses are more expensive (or require installation of additional equipment). Bus operators have not been given clear signals to shift to clean fuels. The government may thus consider introducing targeted tax exemptions for CNG/LPG vehicles and for owners of re-fuelling stations, which the United Nations Development Programme (UNDP) study clearly recommends (UNDP, 2015).
- **Increase support to producers of clean buses**. Kazakhstan has limited bus production (in Kostanay and Semey), but bus producers have no incentive to introduce clean engines. As noted earlier, Kazakhstan is rich in natural gas and could promote local production of clean engines that would encourage the use of clean fuels. This programme focuses on public transport operators, but another programme could introduce incentives for manufacturing and procuring efficient buses running on alternative fuels (CNG, LPG) with lower CO_2 emissions.

Adjusting the fare system for urban public transport

Fares should be aligned with good international practices and designed to maximise the social welfare of both passengers and public transport providers (subject to budget and capacity constraints).

The benefit of providers of public transport services can be defined as revenues minus costs. The benefit for the user of such services can be expressed as the generalised price citizens are willing to pay before switching to non-public transport alternatives, minus the actual generalised price of the ticket. To some extent, the producer benefit and user benefit may be negatively correlated.

Given the economic and financial situation of public transport providers in Kazakhstan, the focus should be on the providers' benefit. The user benefit should be minimised as much as possible (possibly close to zero).

Apart from single fares, subscription fares could also be considered. This option is usually favoured by passengers who do not own a car and are therefore less price sensitive. On the other hand, in developing countries, people who do not own a car usually belong to lower income groups than in the developed world.

Usually, a single or monthly ticket fare system is considered more operator friendly, and a distance-dependent fare system seems more customer-oriented (and more technically demanding for the operator). A single or monthly ticket fare system is generally more attractive for passengers travelling longer distances, and a distance-dependent fare system more attractive for passengers travelling shorter distances.

Finally, with a distance-dependent fare system, the operator can gather information both on the number of trips per route over a defined period and the average length of the route that a passenger travels in a given period. This information may be useful for making better management decisions.

Such changes in the fare system, coupled with the introduction of separated bus lanes and smart traffic lights, could improve the overall management of the public road transport sector in Kazakhstan.

In 2016, the UNDP held discussions with some Akimats around these issues, and they jointly proposed amendments in relevant legislation.

Improving inter-ministerial co-operation in implementation of the transport strategy

Adequately addressing environmental and public health issues through investments in clean technologies for urban public transport requires effective inter-ministerial co-operation. While experience from other projects has shown that such co-operation can be challenging to implement in practice, the involvement of other ministries (in addition to the Ministry of Energy) can help increase the chances of success of such a transport investment programme. The Ministry of Investments and Development (in particular, its Transport Committee) has a crucial role to play in this process. One way to increase the profile of environment on the transport policy agenda, which currently is not among the ministry's priorities, is to introduce clear environmental indicators (e.g. air quality indicators) in transport-related strategic and policy documents. Better co-operation could also help improve the collection and availability of data on urban transport, which can be used in policy analysis. Some of this information (e.g. disaggregated data on bus fleet age or types of fuel used) are dispersed across the Akimats and are not yet collected at the national level. The lack of this information makes it difficult for the government to see the full picture, and presents an obstacle for policy making and progress toward clean transport. In addition, the Ministry of Finance and the Ministry of Economy could also support the programme contributing to low-carbon mobility in Kazakhstan.

Changes in public tenders for providing public transport in urban centres

Currently, most of the public transport operators are selected for short-term contracts. This approach encourages a short-term perspective and incentivises operators to minimise their outlay and make a return on their investment during the period over which their contract is valid. As a result, operators tend to favour cheaper, older and thus more polluting buses. Switching to an approach with medium- to long-term contracts would award contracts to operators likely to invest in a modern bus fleet.

UNDP and European Bank of Reconstruction and Development projects are currently addressing some of the main shortcomings of public tender procedures in Kazakhstan.

Encouraging energy efficiency in public transport

Fuel and related cost savings can be achieved by increasing efficiency in the operation of public transport. For example, dedicated bus lanes can reduce the need to use inefficient mechanical braking. Eco-driving, a driving awareness technique that can reduce fuel consumption, can be introduced and promoted at schools for bus drivers.

In 2013, the City of Almaty – supported by the UNDP-Global Environment Facility (GEF) City of Almaty Sustainable Transport Project – drafted and adopted the City of Almaty Sustainable Transport Strategy 2013-23 (Akimat of Almaty, 2013). Among the sustainable transport options, the project supports measures promoting cycling, such as annual bicycle races for children and training at the cycling school. In 2014, projects for building a bus rapid transit (BRT) corridor and a new bike lane were presented to and approved by the Mayor of Almaty.[6]

Combining such regulatory improvements with financial support from the state is more likely to lead to the modernisation of the bus fleet in Kazakhstan and result in significant reductions in air pollution and GHG emissions.

Conclusions for the CPT Programme

The optimal institutional set-up for managing the resources of the investment programme should be selected only after all elements of the programme are clarified and consensus has been reached on its priorities. Various institutional forms can be established to manage the programme. Regardless of the institutional form, however, the programme management should involve an institutional structure and procedures that promote environmental effectiveness, embody fiscal prudence, and utilise financial and human resources efficiently.

Notes

1. See www.aifc.kz/. The AIFC is a financial hub for Central Asia, the Caucasus, Eurasian Economic Union, the Middle East, West China, Mongolia and Europe. At present, the AIFC does not consider it possible to serve as an implementing unit. AIFC could, however, provide support in mobilising concessional finance, for example based on tax exemptions, whether personal income tax, corporate income tax or land and property taxes, until 2066.
2. See information on Zhasyl Damu, http://zhasyldamu.kz/en/. The main mission of Zhasyl Damu is to create the conditions for the conservation, restoration and improvement of the environment.
3. The Social Entrepreneurial Corporations and regional development institutions. There are 16 such corporations in Kazakhstan.
4. The numbers are provided as an illustration.
5. Given the nature of the projects to be financed, the grant should be determined at a level at which the net present value (NPV) for the project is equal to zero.
6. A BRT corridor is a section of road or contiguous roads served by a bus route or multiple bus routes with a minimum of 3 kilometres and dedicated bus lanes. See information on UNDP in Kazakhstan, on the City of Almaty Sustainable Project, www.kz.undp.org/content/kazakhstan/en/home/operations/projects/environment_and_energy/city-almaty-sustainable-transport.html.

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Chapter 7

Proposed procedures for project cycle management

This chapter presents an overview of the project cycle management (PCM) procedures, developed for each project pipeline identified as part of this programme. Essentially, the PCM procedures are the responsibility of the implementation unit. A well-designed PCM procedure ensures that similar projects compete for public support and that the most cost-effective ones should be selected for financing and implementation.

Pilot phase

Two cities, Kostanay and Shymkent, were selected for the pilot phase in the preparation of the Clean public Transport (CPT) Programme document. For the implementation of the pilot phase, it is recommended that a simplified procedure be followed based on negotiations between the city administration, oblast Akimats and beneficiaries (private operators of the public transport system). The Ministry of Energy, being responsible for overall oversight of the programme, shall give clear directions to local administrations, in particular on:

- the amount of funds allocated for the pilot phase for each city;
- the maximum share of co-financing from public funds;
- the criteria that pilot projects should meet in order to be deemed eligible for financing (possible eligibility criteria are described in Annex D).

After successful negotiations with the beneficiary, the pilot projects should be implemented on a local level and managed and overseen by the respective Akimat. The Akimat may perform most of this activity through the JSC National Company Socio-Entrepreneurial Corporation, which exists in each region in Kazakhstan.[1] The general procedures for project implementation and monitoring should be similar to the one described for the second phase, as discussed below.

Second phase

The project cycle management that will be applied during the second phase of the programme will be more complex. It will consist of several distinct stages, including: *i)* identification of projects, *ii)* development of projects, *iii)* project eligibility assessment, *iv)* appraisal and ranking of projects, *v)* selection of projects for financing, *vi)* financing of projects, *vii)* implementation of projects. Each of these stages is detailed in the sections below.

Identification of eligible projects

The first step in project cycle management (PCM) is to identify eligible projects that respond to the strategic and specific objectives of the national environmental/climate and energy policy, as well as the objectives defined in the CPT Programme. As discussed earlier, eligible projects are selected from the following areas:

- Replacement of buses more than 10 years old that provide public transport services in urban centres with environmentally-acceptable models equipped with diesel, CNG or LPG-powered engines.
- All other investments (studies, construction of CNG filling stations, establishment of a maintenance workshop for new buses, and additional investments that improve public transport services) must accompany bus replacements in the three pipelines (CNG, LPG and diesel).
- Only investment projects (i.e. those involving capital outlays) are eligible for financing under this programme. The list of eligible projects will be reviewed on an annual basis by the implementation unit to ensure that the list remain responsive to national environmental/climate and energy policy objectives.

Development of projects

The second step defines the manner in which projects are developed. The Implementation Unit (IU) will actively promote the CPT Programme by distributing information about it as part of a formal call for proposals (CfP). This will involve the publication of application guidelines to be distributed to potential beneficiaries, in which eligible projects, eligible beneficiaries, eligibility and appraisal criteria, and the type of financing are defined. In addition, the project application form will be complemented by a guide describing how the form should be completed (an example of a project application form is given in Annex C to this report).

Eligibility assessment of projects

The implementation unit (IU) will select a small group of professionals to participate in the review and evaluation of projects. This division should have the necessary technical and financial experts capable of evaluating whether the project meets the CPT Programme objectives and complies with the eligibility criteria.

The **eligibility assessment** involves the screening of projects for compliance with eligibility criteria (detailed in Annex E). If a project does not comply with the eligibility criteria (i.e. if it receives a "no" response to any of the questions in the eligibility assessment), it is rejected and a written explanation is sent to the applicant. The project may be re-evaluated by the technical and financial experts upon modification and re-submission of the project during the next call for proposals (CfP).

The IU also checks the application for completeness. After ensuring that the prospective beneficiary has provided all necessary information, the project can be appraised and ranked. This procedure should take no more than ten (10) working days from receipt of all project proposals submitted before the CfP deadline.

If a project is deemed compliant with the eligibility criteria, but the prospective beneficiary has not submitted all necessary documentation, the IU contacts the applicant and requests clarifications. Providing that the missing information and/or documentation is made available within five (5) working days of the date of communication with the applicant, the project can qualify for full appraisal and ranking.

Appraisal and ranking of projects

The division responsible for assessing project eligibility then undertakes the appraisal and ranking of qualified projects. For those projects that have passed the eligibility assessment (i.e. those projects that have received a "yes" response to **all** questions on the eligibility criteria list), a formal, full **project appraisal** is conducted.

This appraisal is based on the criteria (see example in Annex E) and the explanation of points and weights for each criterion and criteria group. In brief, each project that has qualified for appraisal is examined for its compliance with each of the appraisal criteria. There are five appraisal criteria groups (i.e. project preparation, project location, project type, project size and environmental efficiency). Based on this examination, the project is awarded points for each criterion. Within each of the five appraisal criteria groups, the points are totalled and multiplied by the weight for each criteria group. The process of technical and economic appraisal of the submitted and qualified projects should be completed within 30 working days from the closing date of the CfP.

Next, the IU experts appointed to do the screening, appraisal and ranking of the submitted projects take the total weighted scores and rank the projects from those that best contribute to achieving the CPT Programme objectives (top) to those that are least responsive to these objectives (bottom). This ranked list is then used for the selection of projects for financing and implementation.

Selection of projects for financing and implementation

Having passed through the previous two stages (eligibility screening and appraisal), the projects are selected for financing and implementation. This involves selecting those projects that rank the highest on the ranking list (in order from the top of the ranking list to the bottom). The process of selection of projects for financing and implementation ends when the budget allocated to the type of projects or the CPT Programme as a whole (whichever comes first) for the given call for proposals is exhausted.

The applicants submitting applications and supporting documentation for those projects that pass the cut-off level for financing are then contacted by the IU management in writing to inform them that their project has been selected for financing. This process should be completed within 30 working days of the closing date of the CfP.

Financing of projects

Once the priority projects have been ranked and selected for financing based on the amount of available funds, the proposed financing scheme for the project needs to be designed. This involves determining the amount of the grant required for the project to be viable, defined as having a net present value (NPV) of zero or greater.

When the proposed financing schedule has been defined, the IU invites the applicant to negotiations and signature of the contract (or a PPP company is formed, as described further below).[2] The contract shall detail the rights and responsibilities of each party to the agreement, measures to be taken in the event of the beneficiary's non-compliance with the terms and conditions of the contract, as well as a disbursement schedule for the financial support. This process should be completed within 60 working days of the closing date of the CfP.

Implementation of projects

If the bus supplier has not already been selected, the beneficiary initiates a tender procedure (in accordance with the public procurement law, if the purchases of this beneficiary fall under this law). Once implementation has commenced, the IU, as per the contract with the beneficiary, maintains the right to monitor and inspect the implementation of the project in a scope not limited to:

- comparing actual to planned results in physical terms (e.g. number of buses; size of buses, i.e. no less than 10 metres in length; engine type, etc.);
- determining whether buses are being used for providing public transport in urban centres;
- monitoring implementation of side investments.

Settling payments with contractors

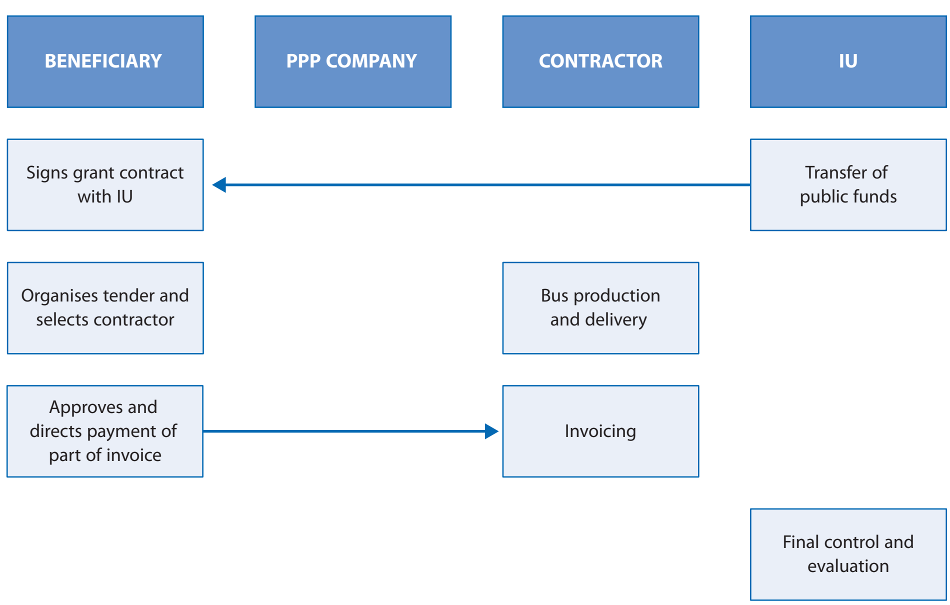
During project implementation, settling payments with contractors is an important practical issue. Three options for settling payments with contractors are suggested, and these include:

- Option 1: The IU transfers the funds to the beneficiary, which pays the contractor/ supplier upon invoicing.
- Option 2: The IU agrees the amount of financing with the beneficiary, but pays the contractor/supplier directly, upon presentation of a copy of the invoice.
- Option 3: A public-private partnership (PPP) company is set up with equity provided by the public financier (through the IU) and the beneficiary, and the IU transfers the funds to the PPP company, which uses them to make payments to the contractor/supplier.

These three options are schematically presented in Figures 7.1-7.3 below.

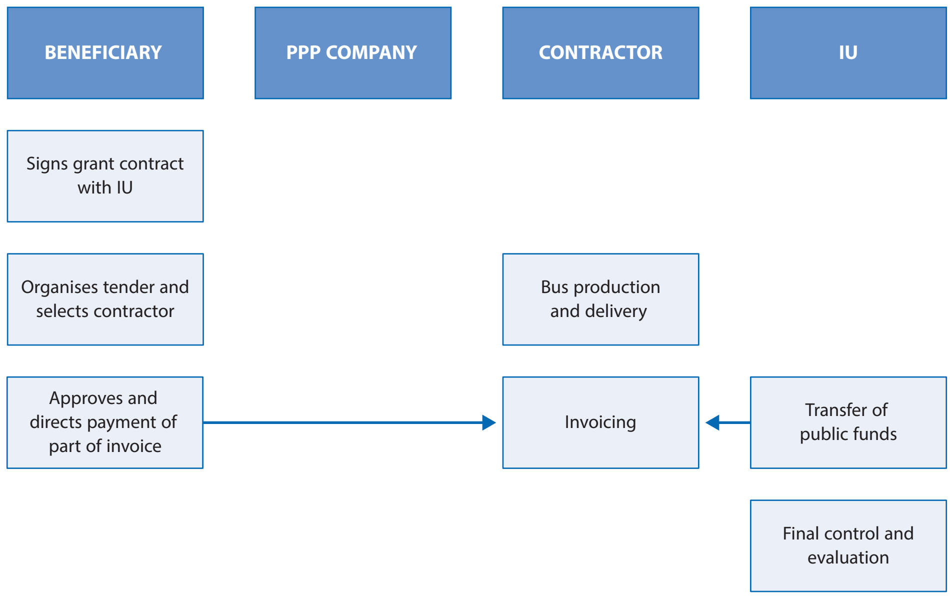
- Public support is transferred to the beneficiary, who organises a tender to select a contractor, the contractor is paid upon delivery of service and submission of invoice.

Figure 7.1. **Payment scheme, Option 1: Beneficiary receives public funds**



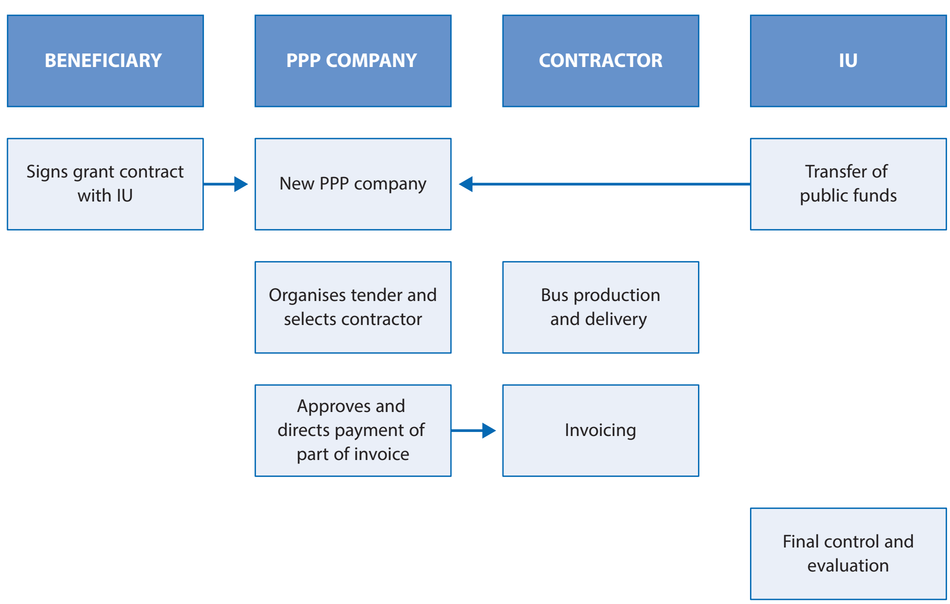
- Public support is transferred to the beneficiary, who organises a tender to select a contractor, but the contractor is paid directly by the IU upon delivery of service and submission of invoice.

Figure 7.2. **Payment scheme, Option 2: Implementation Unit pays the contractor directly**



- Public support is transferred as equity to the newly-established PPP company, and the company organises a tender and proceeds with payments.

Figure 7.3. **Payment scheme, Option 3: PPP company receives public funds as equity**



Control and monitoring of project effects

In contrast to the control and monitoring procedures during project implementation, post implementation control and monitoring (*ex post* evaluation) involves determining whether the project has met its stated objectives. Control and monitoring of project effects is a primary responsibility of the IU, which further reports the results to the Ministry of Energy (manager of the CPT Programme).

Since direct and immediate measurement of project outcomes in terms of air pollution reduction and fuel consumption is very difficult, it is proposed that only the physical outcomes of the project should be monitored, namely:

- the number of buses by engine type and whether buses are used to provide public transport services in urban centres;
- verification that emission reduction equipment remains installed in diesel engines;
- implementation of accompanying investments.

If objectives have not been met, the beneficiary may have to return some or all of the financial support provided under the programme. The contract must clearly regulate such an eventuality.

Maintenance of a database of project and programme effects

Finally, a key element of PCM is creating and maintaining a database of project and programme effects. The IU should determine the best format for the database, such as an Excel-based system or a database software. The following parameters need to be reflected and maintained in the database:

- ***Programme*:**
  - expenditures by CfP and by year (if different) for each type of a project;
  - actual expenditures compared to those budgeted;
  - calculated emission reductions by CfP and by year (if different).
- ***Projects*:**
  - number of projects by type, by CfP and by year (if different);
  - physical outcomes by year: number of buses by engine type;
  - calculated emission reductions by year (estimated based on buses replaced);
  - project cost-effectiveness: cost per unit of emission reduction.

The database should be used to inform future Calls for Proposals in order to adjust eligibility and appraisal criteria as needed and in order to ensure relevancy.

Conclusions for the CPT Programme

The major purpose of public support is to provide incentives to local communities and enterprises to undertake green investments, by spending more of their own resources. The rate of assistance (subsidy rate) should be set to ensure that it does not replace, but rather leverages, the beneficiary's spending. Thus, public resources should be seen as the source of last resort for covering the financing gap of green priority projects (principle of additionality).

For this reason, the level of the subsidy should be kept at the absolute minimum. This optimal minimum can be defined as the rate of assistance that makes environmentally and economically important projects financially viable.

Some of the main conclusions that emerged from the discussion of programming and project cycle management include:

- **Programming is a political process**, focused on defining priorities and goals and setting out rules for the project cycle (e.g. Ministry of Energy). **Appraisal is conducted by professional technical staff** (e.g. the implementation unit), who are held accountable for their decisions. Responsibilities for programming and project cycle management should be separated.
- **Transparency is key**. Information (on project cycle procedures, eligibility criteria, and achieved results and benefits) should be disseminated widely. All potential applicants should be treated equally; decisions should be explained on time; stakeholders should be invited to participate.
- **A two-step appraisal process is preferable** (particularly with larger investment projects), as it allows preliminary screening on the basis of eligibility criteria, thus saving the time and resources of both applicants and programme managers.
- **Simple and traceable appraisal procedures and criteria** should be preferred and cost-effectiveness (cost per unit of emission reduction) should be a major selection criteria.
- **The process does not stop once a decision to finance a project has been made**: contracting, monitoring project implementation and assessing project outcomes are also essential, as programme managers will learn from this experience.
- **Attracting and retaining qualified staff is key**: the capacity to challenge project owners and to manage the complex process of project appraisal requires experience in the field.

Notes

1. Including SPK Tobol (www.spk-tobol.kz) in Kostanay and SKP Shymkent (www.spk-shymkent.kz) in Shymkent.
2. Most likely, this would be a new PPP company, as there are no existing PPPs of this kind.

Annex A

Overview of clean technologies and fuels in the transport sector

This overview looks at buses that run on four major types of clean fuels. These include: compressed natural gas (CNG), liquefied petroleum gas (LPG), diesel with Euro VI engines and electricity. The section on electric buses is shorter, as it is not considered a feasible option for Kazakhstan.

Each fuel type is discussed in terms of four main issues, namely:

- description of the main features of the fuel;
- comparative advantages of the technology;
- comparative drawbacks of the technology; and
- worldwide market penetration of the technology.

Compressed natural gas buses

Compressed natural gas (CNG) is a natural gas under pressure that remains clear, odourless and non-corrosive. Although vehicles can use natural gas as either a liquid or a gas, most vehicles use the gaseous form, compressed to pressures about 218 kg/cm^2. CNG can be used in place of petrol, diesel fuel and propane/LNG. CNG is found above oil deposits or may be collected from landfills or wastewater treatment plants, where it is known as biogas.

It is stored and distributed in hard containers at a pressure of 20-25 MPa (Megapascals), usually in cylindrical or spherical shapes. Most natural gas comes from three types of wells: natural gas-and-condensate wells, oil wells and coal bed methane wells. Well-extracted natural gas requires treatment before it can be used in vehicles.

CNG is used in traditional petrol/internal combustion engine automobiles that have been modified or in vehicles specially manufactured for CNG use, either with a dedicated system separate from the petrol system to extend range (dual-fuel), or in conjunction with another fuel, such as diesel (bi-fuel). CNG vehicles have been introduced in a variety of commercial applications, from light-duty trucks and sedans, like taxicabs, to medium-duty trucks, like UPS (United Parcel Service) delivery vans and postal vehicles, and heavy-duty vehicles such as transit buses, street sweepers and school buses.

CNG's volumetric energy density is estimated to be 42% of that of LNG (because it is not liquefied) and 25% that of diesel fuel.

Box A.1. **Main differences between CNG and LNG**

CNG and LNG are often confused. However, while both are stored forms of natural gas, the key difference is that CNG is gas that is stored (as a gas) at high pressure, while LNG is stored at very low temperature, becoming liquid in the process. CNG has a lower cost of production and storage compared to LNG, as it does not require an expensive cooling process and cryogenic tanks. CNG requires the use of very high pressures and a much larger volume of storage for the same mass of petrol. Therefore, natural gas is often transported over large distances in form of LNG – in ships, trains or pipelines – and then converted into CNG before distribution to the end user.

Advantages

CNG combustion produces fewer undesirable gases than other fuels and is safer in the event of a spill, because natural gas is lighter than air and disperses quickly when released.

Natural gas is produced worldwide at a relatively low cost and is cleaner burning than petrol or diesel fuel. Natural gas vehicles show an average reduction in ozone-forming emissions of 80% compared to petrol-powered vehicles. In addition:

- CNG does not contain any lead, thereby eliminating fouling of spark plugs;
- CNG-powered vehicles have lower maintenance costs than other hydrocarbon-fuel-powered vehicles;
- CNG fuel systems are sealed, preventing fuel losses from spills or evaporation;
- CNG-powered vehicles are considered to be safer than petrol-powered vehicles;
- CNG-powered vehicles produce less pollution and more efficiency.

CNG emits significantly less pollution directly than petrol or oil when combusted. An engine running on petrol emits 22 kilograms of CO_2 per 100 kilometres, and on CNG 16.3 kilograms of CO_2.

Due to low CO_2 emissions, switching to CNG can help mitigate greenhouse gas (GHG) emissions. However, natural gas leaks increase GHG emissions. The ability of CNG to reduce GHG emissions over the entire fuel lifecycle will depend on the source of the natural gas and the fuel it replaces.

Natural gas emits 30% less CO_2 per British thermal unit (BTU) than oil, 90% fewer particulates than conventional fuels, and fewer pollutants such as SO_2 and nitrogen oxide.

Drawbacks

The cost of fuel storage tanks is a major barrier to more widespread and rapid adoption of CNG as a fuel. Municipal governments are the most visible adopters of the fuel in public transport vehicles, as they can more quickly amortise the money invested in the new (and usually cheaper) fuel. In other parts of the world, as the industry has expanded, the cost of fuel storage tanks has fallen.

CNG vehicles require bigger fuel tanks than conventional petrol-powered vehicles. Since it is a compressed gas, rather than a liquid like petrol, CNG takes up more space for each GGE (gasoline gallon equivalent).[1] Usually, CNG tanks take up space in the trunk of cars or bed of pickup trucks modified to additionally run on CNG. This problem is solved in CNG vehicles that have factory-built tanks under the body of the vehicle, leaving the trunk free. Another option is installation on roof (typical for buses), which requires attention to issues of structural strength. In 2014, a test of Euro VI heavy vehicles on CNG and diesel, conducted by the Danish Technological Institute,[2] showed that CNG had a higher consumption of fuel but that NO_x emissions were lower. The level of noise, CO_2 and particulate pollution levels were the same.

Further, investors may be reluctant to invest in infrastructure if an insufficient number of alternative fuel vehicles are in use, while the manufacturing industry does not offer alternative fuel vehicles at competitive prices, since demand is low because consumers are reluctant to buy such vehicles given the lack of an alternative fuel infrastructure.

Market penetration worldwide

CNG-powered vehicles are increasingly used in Iran, Pakistan, the Asian-Pacific region, the Indian capital of Delhi, and large cities like Ahmedabad, Mumbai, Kolkata, Lucknow and Kanpur. Their use is also increasing in South America, Europe and North America given rising petrol prices.

While the number of vehicles in the world using CNG continues to grow steadily, alternative fuel vehicles only represented 3.4% of the European car fleet in 2012, and the use of alternative fuels in heavy-duty vehicles and maritime and aviation modes is negligible (EC, 2016a).

About 1.2 mln vehicles running on CNG in Europe represent 0.7% of the EU-28 vehicle fleet including Switzerland, and Italy accounts for 75% of the market. More than 3 000 re-fuelling points are available, two-thirds of them in Germany and Italy. In total, 18 mln CNG vehicles are in operation worldwide, representing 1.2% of the world's vehicle fleet (EC, 2016a).

India and China have witnessed a rapid growth in recent years, and India, in particular, is forecast to become the world's largest natural gas vehicle market (EC, 2016b).

LPG buses (where CNG is not available)

Also known as propane-butane, LPG is a flammable mixture of hydrocarbon gases used as fuel in heating appliances, cooking equipment and vehicles. LPG is prepared by refining petroleum (crude oil) or "wet" natural gas extracted from petroleum or natural gas streams as they emerge from the ground. It currently provides about 3% of all energy consumed worldwide, and burns relatively cleanly, without soot and very few sulphur emissions. As a gas, it does not pose ground or water pollution hazards, but it can contribute to air pollution. Further, its energy density per unit of volume is lower than either that of petrol or fuel oil, as its relative density is lower.

In some countries, LPG has been used since the 1940s as an alternative to petrol for spark ignition engines. In some cases, additives in the liquid extend engine life, and the ratio of butane to propane is kept quite precise in fuel LPG. Two recent studies have examined LPG/fuel oil fuel mixes and found that smoke emissions and fuel consumption are reduced but hydrocarbon emissions are increased. The studies were split on carbon monoxide (CO) emissions, with one finding significant increases, and the other finding slight increases at low engine load but a considerable decrease at high engine load.

LPG has a lower energy density than either petrol or fuel oil, so the equivalent fuel consumption is about 10% higher. Many governments impose lower taxes on LPG than on petrol or fuel oil, which helps offset the greater consumption of LPG. It is the third most widely used motor fuel in the world. Estimates from 2013 show that over 24.9 mln vehicles are fuelled by LPG worldwide. Over 25 mln tonnes are used annually as a vehicle fuel.

Advantages

LPG is non-toxic, non-corrosive and free of tetraethyl lead or any additives, and has a high octane rating. It burns more cleanly than petrol or fuel oil and is especially free of the particulates present in the latter.

Commercially available LPG is currently derived mainly from fossil fuels. Burning LPG releases CO_2. The reaction also produces some carbon monoxide. LPG does, however, release less CO_2 per unit of energy than coal or oil. It emits 81% of CO_2 per kWh produced by oil, 70% of that of coal, and less than 50% of that emitted by coal-generated electricity distributed via the grid.

Other advantages of LPG include:

- LPG burns more cleanly than higher molecular weight hydrocarbons, because it releases fewer particulates.
- The inherent advantage of LPG over CNG is that it requires far less compression (20% of CNG cost), is denser (because it is a liquid at room temperature) and thus requires far cheaper tanks (consumer) and fuel compressors (providers) than CNG.
- Its advantages over petrol and diesel include cleaner emissions and less wear on engines over petrol.

Drawbacks

LPG main disadvantages may be summarised as follows:

- Safety: The fuel is heavier than air, which causes it to collect in a low spot in the event of a leak, making it much more hazardous to use; more care is needed in handling.
- Environment: LPG is not as efficient or environmentally friendly as CNG and electric options for alternative fuels for buses.
- Technology: LPG provides less upper cylinder lubrication than petrol or diesel, so LPG-fuelled engines are more prone to valve wear if they are not appropriately modified.

Market penetration (worldwide)

LPG is losing momentum in the European Union, United States of America and Japan, because, in comparison to electric mobility and even CNG, its environmental benefits over conventional fuels are limited. However, LPG is still promising in developing markets in China, India and the Russian Federation.

LPG is currently the most adopted alternative fuel in road transport in terms of number of vehicles. The LPG market is dominated, in terms of vehicles, by five countries, which together account for almost half of global consumption: Turkey (4 mln vehicles), the Russian Federation (3 mln), Poland (2.8 mln), Korea (2.4 mln) and Italy (2 mln) (EC, 2016b).

Diesel buses with Euro VI engines

Petrol and diesel remain the most common fuels for all vehicles. For example, United States regulations attempting to reduce the impact of these fossil fuels on the environment have mandated the supply of ultra-low sulphur diesel and the use of ethanol (also known as E85) in petrol.

Biodiesel is brought to the market mainly via blending with conventional diesel. The largest market is the European Union, followed by the United States and Brazil. Biodiesel does not reduce NO_x emissions from vehicles, which is an increasing focus of attention for cities.

Tables A.1 and A.2 contain a summary of the emission standards for diesel buses and their implementation dates, with two different types of testing requirements: *i)* Steady State Testing (Table A.1) which lists emission standards applicable to diesel (compression ignition, or CI) engines only, with steady-state emission testing requirements; and *ii)* Transient Testing (Table A.2) which lists standards applicable to both diesel and gas (positive ignition, PI) engines with transient testing requirements.

Table A.1. **EU emission standards for heavy-duty diesel engines, steady-state testing**

			CO	HC	NO_x	PM	PN	Smoke
Tier	**Date**	**Test cycle**	*g/kWh*				*1/kWh*	*1/m*
Euro I	1992 < 85 kW	ECE Regulation-49	4.5	1.1	8.0	0.612		
	1992 > 85 kW		4.5	1.1	8.0	0.36		
Euro II	October 1996		4.0	1.1	7.0	0.25		
	October 1998		4.0	1.1	7.0	0.15		
Euro III	*October 1999 Enhanced environmentally friendly vehicles (EEVs) only*	European Stationary Cycle (ESC) and European Load Response (ELR)	*1.5*	*0.25*	*2.0*	*0.02*		*0.15*
	October 2000		2.1	0.66	5.0	0.10-0.13[a]		0.8
Euro IV	October 2005		1.5	0.46	3.5	0.02		0.5
Euro V	October 2008		1.5	0.46	2.0	0.02		0.5
Euro VI	31 December 2013	World Harmonized Stationary Cycle (WHSC)	1.5	0.13	0.4	0.01	8.0×10^{11}	

Source: DieselNet (2016).

Note: a. PM = 0.13 g/kWh for engines < 0.75 dm^3 swept volume per cylinder and a rated power speed > 3 000 min^{-1}.

Table A.2. **EU emission standards for heavy-duty diesel engines, transient testing**

			CO	NMHC	CH_4 [a]	NO_x	PM [b]	PN [c]
Tier	**Date**	**Test cycle**	*g/kWh*					*1/kWh*
Euro III	*October 1999 Enhanced environmentally friendly vehicles (EEVs) only*	European Transient Cycle (ETC)	*3.0*	*0.40*	*0.65*	*2.0*	*0.02*	
	October 2000		5.45	0.78	1.6	5.0	0.16[d]	
Euro IV	October 2005		4.0	0.55	1.1	3.5	0.03	
Euro V	October 2008		4.0	0.55	1.1	2.0	0.03	
Euro VI	31 December 2013	World Harmonized Transient Cycle (WHTC)	4.0	0.16[e]	0.5	0.46	0.01	6.0×10^{11}

Source: DieselNet (2016).

Notes: a. for gas engines only (Euro III-V: NG only; Euro VI: NG + LPG).

b. not applicable to gas-fuelled engines at the Euro III-IV stages.

c. for diesel engines; particle number (PN) limit for positive ignition engines to be defined.

d. PM=0.21 g/kWh for engines < 0.75 dm^3 swept volume per cylinder and a rated power speed > 3 000 min^{-1}.

e. Total hydrocarbon content (THC) for diesel engines.

Some of the main advantages of diesel buses with Euro VI engines include the following:

- The purchase price of modern diesel-fuelled engines is typically less than moving to cleaner technologies (such as LPG or CNG).
- The need for additional investments in the vehicle itself or in supporting infrastructure is not as great as for LPG and CNG, which often require vehicle modifications or supporting infrastructure.
- A standard diesel city bus delivers lower carbon emissions per rider, and reducing CO_2 emissions can be achieved by encouraging more passengers to shift to public transport.

Drawbacks

The main drawbacks of diesel buses with Euro VI engines are:

- The shift from Euro V to Euro VI for heavy-duty vehicles will require considerable investments for manufacturers and public transport undertakings and huge outlays from bus manufacturers.
- They cause significant harm to the environment, in the form of particulate matter (PM) from engine exhaust.

Market penetration world wide

Diesel engines are globally one of the most common choices for combustion engines for buses and other commercial vehicles. For the time being, diesel and biodiesel buses constitute by far the greatest part of the bus fleet (90% of the bus fleets in Europe, according to the results of the 3iBS survey, which surveyed 70 000 buses operated in 63 European cities and regions) (UITP, 2015).

Electric buses

Expansion of electrification of road transport to urban buses is a rising trend in Europe, with electric buses expected to reach market maturity soon. However, the full battery electrification of heavy-duty vehicles and long-haul bus and coach fleets is not a realistic option in the near future.

Box A.2. **Electricity production**

Electricity is an energy carrier that can be converted domestically from a wide variety of primary energy sources. A certain quantity of electricity can be produced from renewable energy sources, offering a nearly well-to-wheel zero-emission pathway, although this is not always the case; e.g. when a combination of renewable and non-renewable sources is used. Electricity will continue to become increasingly low-carbon as the power sector continues to reduce carbon intensity.

Due to current limits in battery capacity and thus driving range (generally 100 to 200 kilometres for a small to medium-sized car), electric vehicles are considered best suited to urban and suburban driving. Recently, new models of Tesla vehicles have increased range up to 300-400 kilometres, and an expansion of electrification of road transport can be expected in the near future. An urban bus may also have a range of around 200 kilometres per charge, but in Kazakhstan, a bus may need to travel 45 000 kilometres a year on average, requiring a charge more than every other day.

The trolleybus is a viable alternative in terms of reducing emissions. In many cities in Kazakhstan, however, new infrastructure would be required that is beyond the scope of the planned programme. Given the required infrastructure investments, public companies would have to be established and largely replace the high number of private transport service providers. For the purposes of this programme, the introduction or expansion of trolleybus services are not anticipated.

Table A.3. **Comparison of fuels to power buses for urban public transport**

Parameter	CNG	LPG	Diesel EEV
Purchase cost (diesel = 100 baseline)	120	110	100 (higher than traditional diesel)
Fuel type	**Natural gas**		**Diesel**
Range (km)	300	500	750
Consumption per 100 kilometres	60-70 m^3	36 kg	40-50 l
Operating costs	+	+	++
Re-fuelling time	Long; 3-6 hours	Quick re-fuelling	Normal
Re-fuelling complications	Average (compression)	Very high (liquefaction, storage)	Low
Noise	Low	Low	Normal
Pollution	Low emissions of particulates, SO_2, NO_x. Nearly zero contribution to smog	Low emissions of particulates, SO_2, NO_x, nearly zero contribution to smog	Lower emissions than traditional diesel. Higher emissions than CNG and LPG
Usage	Small/medium buses	Large buses	All types
Other opportunities and advantages	Fuel can also be made from biomass or landfill gas.	Low temperatures in winter will support LNG storage.	
Other challenges and disadvantages	Heavy fuel tanks and buses with higher clearance required Dedicated fuelling stations required (for example, at bus depot) Dedicated workshops required Rapid re-fuelling requires expensive infrastructure investment and may lead to gas leaks	Limited storage time for LNG Buses have to be constantly used, and after five days without use requires venting Fuel is transported and stored at low temperature Requires complicated installations for cleaning and liquefaction at stations	New norms may impose changing them in the future

Source: OECD CPT Programme OPTIC Model.

Market penetration worldwide

Market penetration is encouraged through a project co-founded by European Commission (EC) Directorate General for Mobility and Transport, through the FP7 Programme on electric buses, ZeEUS or Zero Emission Urban Bus System. The main objective of this programme is to bring electrification to the heart of the urban bus network by testing electronic solutions through live operational demonstrations on high-capacity buses and by facilitating the market uptake of electric buses in Europe.[3] Ten demonstration cities are included in the programme: Barcelona, London, Paris, Cagliari, Bonn, Münster, Randstad, Stockholm and Warsaw.

The share of electric vehicles was 0.1% (1 mln) of the global vehicle fleet as of the end of 2015 and is growing rapidly.

Notes

1. GGE is the amount of alternative fuel it takes to equal the energy content of one liquid gallon (ca. 3.785 litres) of petrol. GGE allows consumers to compare the energy content of competing fuels against a commonly known fuel, petrol. GGE also compares petrol to fuels sold as a gas (natural gas, propane or hydrogen) and electricity.
2. See https://www.dti.dk/specialists/emission-reduction/37141 (accessed 20 March 2017).
3. See http://zeeus.eu (accessed 3 March 2017).

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Annex B

Explanatory guide for the use of the OPTIC model

Purpose of the OPTIC model

The purpose of the spreadsheet-based OPTIC model is to support the Government of Kazakhstan in the preparation and, in particular, the estimation of the costs and environmental benefits of the Clean Public Transport (CPT) Programme. It was agreed with the Ministry of Energy of Kazakhstan that the programme will comprise two project pipelines:

- Replacement of the old bus fleet in urban centres with modern buses equipped with engines that run on:
  a. compressed natural gas (CNG);
  b. liquefied petroleum gas (LPG);
  c. diesel, but possibly the use/import of Euro V/VI fuel.

  As the bus fleet in Kazakhstan is ageing, the proposed pipelines are intended to support the purchase of new buses and not just the modernisation of engines.
- Side investments to improve the transport system in urban centres (e.g. the creation of bus lanes and smart traffic control).

As the bus fleet in Kazakhstan is ageing (see Figures 3.5 and 3.6), the proposed pipelines are intended to support the purchase of new buses and not just the modernisation of engines.

The programme here is understood not to mean the software but a broad area of activities required to implement policy decisions and priorities. The spreadsheet-based OPTIC model is a simple, easy-to-use decision support tool prepared exclusively to estimate programme costs, CO_2 emission reductions and emission reductions of other pollutants from urban public transport (CO, NO_x, PM, SO_2) that could potentially be achieved by implementing the proposed project pipelines.

Other types of similar models that exist on the market are focused on the estimation of the GHG emission reductions for a country or for groups of countries. These models mainly focus on GHG emissions from industry and take into account different scenarios for the country's economic development. These types of models, however, are not particularly suitable for the purpose of this investment programme, which focuses on reducing emissions from urban public transport only.

Overall structure of the OPTIC model

The OPTIC model consists of seven modules: *i)* assumptions; *ii)* emission factors; *iii)* transport sector overview with information on current bus fleet and age; *iv)* determining the subsidy level; *v)* cost calculation; *vi)* emission reductions calculation; *vii)* programme costing and environmental effects.

The model has been prepared in Excel and uses macros. Therefore, when starting the model, the macros in Excel should be enabled. This requires that the security settings be set to "medium." For earlier versions of Excel, security settings can be changed using the following commands: Tools>Macros>Security. For Excel 2010 and 2013, the macro security settings can be set in the "Developer" tab. If the Developer tab is not visible, it can be accessed by going to: File>Options>Customize Ribbon and then selecting Developer from the options in the right-hand window.

Preparations to start using the OPTIC model

The user shall fill the cells that are highlighted yellow in the Excel sheets.

First, users need to complete the information on assumptions and emission factors. Assumptions can be found under the "Assumptions" tab. The following information is essential for the model:

- the average price of a new CNG bus;
- the average price of a new LPG bus;
- the average price of a new diesel bus equipped with a Euro VI engine.

For the purpose of this model, the average bus is understood to be a 12-metre-long bus with total capacity of about 100 passengers (for example, Daewoo GDW6126 CNG).

Then, the average level of fuel consumption of each bus has to be provided. This information will also include old diesel buses that will be replaced. For the purpose of the model, old diesel buses were divided into several categories: new and more than 5, 10 and 15 years old.

Next, the information on fuel costs for each type of bus has to be provided. The information on average kilometres per vehicle per day (kpvpd),[1] which is found in the last column in Table B.1, is essential.

Table B.1. **Basic assumptions: bus prices and fuel consumption**

	Average price	Fuel consumption		Fuel costs		kpvpd
Bus type	***KZT 1 000***		***Unit***		***Unit***	***km***
New CNG bus	35 315	53.7	m^3/100 km	58	KZT/m^3	200
New LPG bus	32 104	70	kg/100 km	51	KZT/l	200
New diesel Euro VI bus	30 708	50	l/100 km	137	KZT/l	200
New diesel standard bus	10 000	45	l/100 km	125	KZT/l	200
Old diesel bus > 15 years		56.25	l/100 km	125	KZT/l	200
Old diesel bus > 10 years		51.75	l/100 km	125	KZT/l	200
Old diesel bus > 5 years		49.50	l/100 km	125	KZT/l	200

Source: OECD CPT Programme OPTIC Model.

After providing information on the basic assumptions, the user next inputs information on emissions from buses. This can be found under the "Emission factors" tab. The emissions will be identified in kilograms or grams of the emitted pollutant per kilometre of bus operation. The information on emissions is key for the calculation of emission reductions (Table B.2).

Table B.2. **Assumed emission factors according to emission norms (per km)**

	CO_2	CO	NO_x	PM2.5	SO_2
Fuel type	***kg/km***	***g/km***			
Diesel Euro 2	1.0812	2.4400	10.7000	0.2200	0.2050
Diesel Euro 2>5 years	1.1893	2.6840	11.7700	0.2420	0.2255
Diesel Euro 2>10 years	1.2974	2.9280	12.8400	0.2640	0.2460
Diesel Euro 2>15 years	1.4056	3.1720	13.9100	0.2860	0.2665
Diesel Euro VI	0.7632	0.2230	0.5970	0.0023	0.0205
CNG (EEV standard)	0.9350	0.2400	2.5000	0.0050	0.0000
LPG	1.0258	1.9200	5.0000	0.0050	0.0652

Source: OECD CPT Programme OPTIC Model.

There are two tables containing emission factors:

- normative emissions according to the standards; and
- real emissions according to actually measured emissions.

The source of information and the reason for providing two different sets of emission factors is discussed at the end of Annex B.

Next, the information on the existing urban public sector in Kazakhstan needs to be provided under the "Transport" tab (as shown in Table B.3). This is done by providing information on the existing bus fleet in the cities of Kazakhstan. The fleet will be divided by age (>15 years, 10-15 years, 5-10 years, < 5 years) and fuel type (diesel, petrol, CNG, LPG). The last columns contain information on the availability of CNG stations, proximity to CNG (a CNG station need not be available, but there should be proximity to a gas pipeline), Diesel Euro V equivalent standard (which is not produced in Kazakhstan, thus requiring import). This information is provided by entering "Yes" or "No" to the respective cells. The information on the bus fleet excludes minibuses.

Table B.3. **Public transport and transport infrastructure in selected cities in Kazakhstan**

			Carrier companies (quantity)		Type of ownership		BUSES											
							Age				Fuel							
No.	Region	City	Public	Private	Private, own	Private, leased	>15 years	10-15 years	5-10 years	< 5 years	Diesel	Petrol	CNG	LPG	Population	Existing CNG stations	Proximity to Diesel5	Proximity to CNG
1	Akmola	Kokshetau city	0	4	127	63	55	72	52	11	114	72	0	4	159 845	No	No	No
2	Aktobe	Aktobe	0	2	531	0	6	69	303	153	443	25	0	63	397 572	No	No	Yes
3	Almaty (Region)	Taldykorgan	0	7	24	238	0	9	87	166	262	0	0	0	140 656	No	No	No
4	Astana City	Astana	1	8	958	108	117	110	350	489	1066	0	0	0	872 655	No	No	No
5	Almaty City	Almaty	0	18	739	746	163	205	327	910	868	0	737	0	1 703 481	Yes	No	Yes
6	Atyrau	Atyrau	0	11	91	52	0	35	20	88	143	0	0		226 110	No	No	Yes
7	East Kazakhstan	Semey	0	6		82	48	34	0	0	5	77	0	0	318 053	No	No	No
8	East Kazakhstan	Ust-Kamenogorsk	0	10	323	185	219	57	164	68	492	16	0	0	321 536	No	No	No
9	Zhambyl	Taraz	0	11	491	104	14	63	167	351	309	230	0	56	362 993	No	No	Yes
10	West Kazakhstan	Uralsk	0	7	208	198	56	54	149	147	309	72	25		232 493	Yes	No	Yes
11	Karaganda	Karaganda	0	9	489	0	297	8	19	165	489				497 824	No	No	No
12	Karaganda	Temyrtau	0	9	125	114	10	8	146	75	115	121		3	178 351	No	No	No
13	Karaganda	Zhezkazgan	0	10	72	0	19	23	25	5	42	20		10		No	No	No
14	Kostanay	Kostanay	0	9	288	131	413	0	0	6	419				231 911	No	No	No
15	Kostanay	Rudniy	0	3	149	9	146	4	5	3	121	7	30		115 980	Yes	No	No
16	Kyzylorda	Kyzylorda	1	0	70	321	46	68	207	70	107	124	90	70	227 499	Yes	No	Yes
17	Pavlodar	Pavlodar	2	7	155	29	78	8	19	79	184				335 214	No	No	No
18	Pavlodar	Ekybastuz	0	3	55	0	24	4	10	17	55				134 091	No	No	No
19	Mangistau	Aktau	0	3	27	39	0	0	38	28	0	0	0	66	183 233	No	No	Yes
20	Mangistau	Zhanaozen	0	3	0	11	1	3	2	5	0	0	0	11	113 377	No	No	Yes
21	North Kazakhstan	Petropavlovsk	0	11	108	56	15	52	17	80	97	39		28	215 306	No	No	No
22	South Kazakhstan	Shymkent	0	29	552	641	61	109	518	505	976		200	17	885 799	Yes	No	Yes
23	South Kazakhstan	Turkestan	0	1	40	10	0	0	15	35	20		30		159 632	Yes	No	Yes
Total			4	181	5 622	3 137	1 788	995	2 640	3 456	6 636	803	1 112	328	8 013 611			

Source: OECD CPT Programme OPTIC Model.

Determining the subsidy level

The **module on determining the subsidy level** takes into account both investment costs and savings that public service providers may achieve by replacing old buses. New buses using alternative fuels are more efficient because of technological improvements and also due to the lower price of CNG and LPG fuels compared to diesel.

The module takes into account the fact that the investments should generate at least a minimum return for public transport providers; thus, the social discount rate is used to determine the net present value (NPV) of the project. The subsidy is then determined at the level at which NPV is equal to zero. The economic significance of this calculation is that the subsidy will encourage potential beneficiaries to participate in the CPT Programme without encouraging the beneficiary to make a profit based on the subsidy. The calculation of the subsidy level for CNG buses is presented in Tables B.4-B.5.

The cost of a new CNG bus (KZT 46.24 mln = USD 135 000) was compared with the average cost of an old bus (KZT 17 264 000 = USD 50 000) that the beneficiary would have purchased without public support.

Table B.4. **Assumptions for calculating the level of public support for CNG buses**

	Fuel consumption	Fuel price	Annual distance	Fuel costs per year
CNG	53.7 m^3/100 km	58 KZT/m^3	46 000 km	KZT 1 424 000
Old diesel	45.0 l/100 km	124.93 KZT/l	46 000 km	KZT 2 586 000
Annual difference				KZT 1 162 000

Source: OECD CPT Programme OPTIC Model.

Next, the savings on fuel costs were considered due to the lower price of CNG. The parameters used to calculate fuel savings are presented in Table B.5.

Table B.5. **Calculation of the level of public support for CNG buses (KZT 1 000)**

Year	0	1	2	3	4	5	6	7	9
Investment costs for a new bus	35 315								
Difference in price compared to a standard bus	25 315								
Required public support	17 055								
Annual fuel cost savings		1 162	1 162	1 162	1 162	1 162	1 162	1 162	1 162
NPV	0								

Source: OECD CPT Programme OPTIC Model.

Similar calculations are made for LPG buses (Tables B.6-B.7) and for modern diesel buses (Tables B.8-B.9).

Table B.6. **Assumptions for calculating the level of public support for LPG buses**

	Fuel consumption	Fuel price	Annual distance	Fuel costs per year
LPG	70 kg/100 km	51 KZT/kg	46 000 km	KZT 1 642 000
Old diesel	45.0 l/100 km	124.93 KZT/l	46 000 km	KZT 2 586 000
Annual difference				KZT 944 000

Source: OECD CPT Programme OPTIC Model.

Table B.7. **Calculation of the level of public support for LPG buses (KZT 1 000)**

Year	0	1	2	3	4	5	6	7	9
Investment costs for a new bus	32 104								
Difference in price compared to a standard bus	22 104								
Required public support	15 395								
Annual fuel cost savings		944	944	944	944	944	944	944	944
NPV	0								

Source: OECD CPT Programme OPTIC Model.

Table B.8. **Assumptions for calculating the level of public support for modern diesel buses**

	Fuel consumption	Fuel price	Annual distance	Fuel costs per year
Diesel Euro VI	50 l/100 km	137.43 KZT/l	46 000 km	KZT 3 161 000
Old diesel	45.0 l/100km	124.93 KZT/l	46 000 km	KZT 2 586 000
Annual difference				KZT -575 000

Source: OECD CPT Programme OPTIC Model.

Table B.9. **Calculation of the level of public support for modern diesel buses (KZT 1 000)**

Year	0	1	2	3	4	5	6	7	9
Investment costs for a new bus	30 708								
Difference in price compared to a standard bus	20 708								
Required public support	24 793								
Annual fuel cost savings		-575	-575	-575	-575	-575	-575	-575	-575
NPV	0								

Source: OECD CPT Programme OPTIC Model.

The above calculations do not take into account possible reduced maintenance costs, as old buses tend to require more maintenance over time. On the other hand, the maintenance of modern technologies, especially when security is a concern in using CNG or LPG, is more expensive, so it is assumed that bus replacement will be neutral in terms of maintenance costs.

The results of the calculation are presented in the tab "Subsidy" (as shown in Table B.10).

Table B.10. **Subsidy calculation for public support for replacement of buses**

	Bus costs	Difference in price compared to standard bus	Annual distance	Fuel costs	Reference fuel costs	Required subsidy for bus	Required subsidy for CNG station	Net price for a bus for beneficiary	Net price for a bus for beneficiary
Type	*KZT 1 000*	*KZT 1 000*	*km*	*KZT 1 000*	*KZT 1 000*	*KZT 1 000*	*KZT 1 000*	*KZT 1 000*	*%*
CNG	35 315	25 315	46 000	1 424	2 586	17 055	544 000	18 260	52%
LPG	32 104	22 104	46 000	1 642	2 586	15 395	0	16 709	52%
Diesel Euro VI	30 708	20 708	46 000	3 161	2 586	24 793	0	5 915	19%

Source: OECD CPT Programme OPTIC Model.

Box B.1. **Determining the optimal subsidy level**

The level of the subsidy should be sufficient to attract potential investors/beneficiaries to apply for support from the CPT Programme without making the implemented projects very profitable. In order to evaluate a given project, the net present value (NPV) is calculated by totalling the expected net cash flows (cash inflows, or receipts, minus cash outflows, or expenses) over the project operating period and discounting them using the rate that reflects the costs of a loan of equivalent risk on the capital market. An investment will yield a profit if the NPV is positive. All measures that yield a positive NPV using a discount rate that corresponds to the applied rate of return can be deemed beneficial. The NPV is calculated as in the following formula:

$$\text{NPV} = \sum_{i=1}^{n} \left(NCF_i \times \frac{1}{(1+r)^i} \right)$$

where:

- NCF_i is the net cash flow in the i-th year
- r is the discount rate.

Using discounting takes into account the investor's expectations with respect to the measure and that it is sufficient that the NPV is greater than zero during sthe operating period.

The calculation of the subsidy level should be based on economic principles: if the project is not profitable for the beneficiary but it is socially significant, the subsidy should make it just profitable. In simple terms, the financial NPV including the subsidy should be approximately at the level of zero KZT, which means that the project yields an acceptable rate of return for the investor/project promoter.

The "determination of the subsidy level" module uses this principle by making a simple financial analysis of the cash inflows and outflows in each year of the analysis. Cash inflows (receipts) generated by the project include fuel savings expressed in terms of the money saved by customers (public transport providers). In terms of cash outflows (expenses), the simple financial analysis totals the difference in investment costs of a clean and traditional bus calculated in the other modules. In the subsidy module, the subsidy is included on the cash outflow side as a negative value.

It was assumed that the investments will be made during the first year of the project and the savings averaged over the nine years of operation. Together, the period of analysis is 10 years, a typical lifetime for this type of project. The subsidy is calculated so that the result of the NPV calculation is equal to zero KZT.

This approach to calculating the subsidy will enable the government to avoid over-investing, while at the same time providing an investment incentive for potential beneficiaries without making it too profitable for investors. Essentially, the subsidy level should provide just the necessary leverage for individual potential beneficiaries to undertake clean transport investments.

Cost calculation

The Cost calculation module under the tab "Costs" shows the estimated investment costs and the required subsidy by the CPT Programme. This information is provided in a table format (as shown in Table B.11) that contains data on the main cities of Kazakhstan, the number of buses to be replaced, the type of new buses, total investment costs, including the costs of constructing CNG stations, the level of subsidy and the net costs to beneficiaries. In this module, users simply input factual information without making any decisions on the programme.

Table B.11. **Investment costs, subsidies and net costs for beneficiaries**

City	Buses to be replaced				New buses			Need for CNG station	Investment costs					Subsidy					Net costs for beneficiary				
	Age				Fuel																		
	>15 years	10-15 years	5-10 years	< 5 years	Diesel	CNG	LPG		Diesel	CNG	LPG	CNG stations	Total	Diesel	CNG	LPG	CNG stations	Total	Diesel	CNG	LPG	CNG stations	Total
Kokshetau city	55	72	0	0	0	0	127	0	0	0	4 077	0	4 077	0	0	1 955	0	1 955	0	0	2 122	0	2 122
Aktobe	6	69	0	0	0	75	0	1	0	2 649	0	544	3 193	0	1 279	0	544	1 823	0	1 369	0	0	1 369
Taldykorgan	0	9	0	0	0	0	9	0	0	0	289	0	289	0	0	139	0	139	0	0	150	0	150
Astana	117	110	0	0	0	0	227	0	0	0	7 288	0	7 288	0	0	3 495	0	3 495	0	0	3 793	0	3 793
Almaty	163	205	0	0	0	368	0	0	0	12 996	0	0	12 996	0	6 276	0	0	6 276	0	6 720	0	0	6 720
Atyrau	0	35	0	0	0	35	0	1	0	1 236	0	544	1 780	0	597	0	544	1 141	0	639	0	0	639
Semey	48	34	0	0	0	0	82	0	0	0	2 633	0	2 633	0	0	1 262	0	1 262	0	0	1 370	0	1 370
Ust-Kamenogorsk	219	57	0	0	0	0	276	0	0	0	8 861	0	8 861	0	0	4 249	0	4 249	0	0	4 612	0	4 612
Taraz	14	63	0	0	0	77	0	1	0	2 719	0	544	3 263	0	1 313	0	544	1 857	0	1 406	0	0	1 406
Uralsk	56	54	0	0	0	110	0	0	0	3 885	0	0	3 885	0	1 876	0	0	1 876	0	2 009	0	0	2 009
Karaganda	297	8	0	0	0	0	305	0	0	0	9 792	0	9 792	0	0	4 695	0	4 695	0	0	5 096	0	5 096
Temyrtau	10	8	0	0	0	0	18	0	0	0	578	0	578	0	0	277	0	277	0	0	301	0	301
Zhezkazgan	19	23	0	0	0	0	42	0	0	0	1 348	0	1 348	0	0	647	0	647	0	0	702	0	702
Kostanay	413	0	0	0	0	0	413	0	0	0	13 259	0	13 259	0	0	6 358	0	6 358	0	0	6 901	0	6 901
Rudniy	146	4	0	0	0	0	150	0	0	0	4 816	0	4 816	0	0	2 309	0	2 309	0	0	2 506	0	2 506
Kyzylorda	46	68	0	0	0	114	0	0	0	4 026	0	0	4 026	0	1 944	0	0	1 944	0	2 082	0	0	2 082
Pavlodar	78	8	0	0	0	0	86	0	0	0	2 761	0	2 761	0	0	1 324	0	1 324	0	0	1 437	0	1 437
Ekybastuz	24	4	0	0	0	0	28	0	0	0	899	0	899	0	0	431	0	431	0	0	468	0	468
Aktau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zhanaozen	1	3	0	0	0	4	0	1	0	141	0	544	685	0	68	0	544	612	0	73	0	0	73
Petropavlovsk	15	52	0	0	0	0	67	0	0	0	2 151	0	2 151	0	0	1 031	0	1 031	0	0	1 120	0	1 120
Shymkent	61	109	0	0	0	170	0	0	0	6 003	0	0	6 003	0	2 899	0	0	2 899	0	3 104	0	0	3 104
Turkestan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1 788	995	0	0	0	953	1 830	4	0	33 655	58 751	2 176	94 581	0	16 253	28 173	2 176	46 602	0	17 401	30 578	0	47 979

Source: OECD CPT Programme OPTIC Model.

Table B.12. **Emission reduction based on the purchase of new buses**

			Buses to be replaced				New buses			Buses to be replaced					New buses					Emission reduction				
			Age				Fuel			Emissions					Emissions									
No.	Region	City	>15 years	10-15 years	5-10 years	< 5 years	Diesel	CNG	LPG	CO2 (t)	CO (kg)	NOx (kg)	PM 2.5 (kg)	SO2 (kg)	CO2 (t)	CO (kg)	NOx (kg)	PM 2.5 (kg)	SO2 (kg)	CO2 (t)	CO (kg)	NOx (kg)	PM 2.5 (kg)	SO2 (kg)
1	Akmola	Kokshetau city	55	72	0	0	0	0	127	11 268	25 428	111 509	2 293	2 136	8 598	16 093	41 910	42	547	2 670	9 335	69 599	2 251	1 590
2	Aktobe	Aktobe	6	69	0	0	0	75	0	6 465	14 590	63 982	1 316	1 226	4 628	1 188	12 375	25	0	1 837	13 402	51 607	1 291	1 226
3	Almaty (Region)	Taldykorgan	0	9	0	0	0	0	9	771	1 739	7 627	157	146	609	1 140	2 970	3	39	161	599	4 657	154	107
4	Astana City	Astana	117	110	0	0	0	0	227	20 273	45 751	200 631	4 125	3 844	15 368	28 765	74 910	75	977	4 905	16 986	125 721	4 050	2 867
5	Almaty City	Almaty	163	205	0	0	0	368	0	32 675	73 740	323 369	6 649	6 195	22 709	5 829	60 720	121	0	9 966	67 911	262 649	6 527	6 195
6	Atyrau	Atyrau	0	35	0	0	0	35	0	2 997	6 764	29 660	610	568	2 160	554	5 775	12	0	837	6 209	23 885	598	568
7	East Kazakhstan	Semey	48	34	0	0	0	0	82	7 364	16 619	72 880	1 498	1 396	5 552	10 391	27 060	27	353	1 813	6 228	45 820	1 471	1 043
8	East Kazakhstan	Ust-Kamenogorsk	219	57	0	0	0	0	276	25 197	56 863	249 359	5 127	4 777	18 686	34 975	91 080	91	1 188	6 511	21 889	158 279	5 036	3 590
9	Zhambyl	Taraz	14	63	0	0	0	77	0	6 693	15 106	66 242	1 362	1 269	4 752	1 220	12 705	25	0	1 942	13 886	53 537	1 337	1 269
10	West Kazakhstan	Uralsk	56	54	0	0	0	110	0	9 819	22 159	97 173	1 998	1 862	6 788	1 742	18 150	36	0	3 031	20 417	79 023	1 962	1 862
11	Karaganda	Karaganda	297	8	0	0	0	0	305	28 237	63 724	279 443	5 746	5 354	20 649	38 650	100 650	101	1 312	7 588	25 074	178 793	5 645	4 041
12	Karaganda	Temyrtau	10	8	0	0	0	0	18	1 613	3 640	15 960	328	306	1 219	2 281	5 940	6	77	394	1 359	10 020	322	228
13	Karaganda	Zhezkazgan	19	23	0	0	0	0	42	3 732	8 422	36 934	759	708	2 843	5 322	13 860	14	181	889	3 100	23 074	746	527
14	Kostanay	Kostanay	413	0	0	0	0	0	413	38 313	86 462	379 159	7 796	7 264	27 961	52 335	136 290	136	1 777	10 352	34 127	242 869	7 659	5 487
15	Kostanay	Rudniy	146	4	0	0	0	0	150	13 887	31 338	137 427	2 826	2 633	10 155	19 008	49 500	50	645	3 731	12 330	87 927	2 776	1 987
16	Kyzylorda	Kyzylorda	46	68	0	0	0	114	0	10 090	22 771	99 857	2 053	1 913	7 035	1 806	18 810	38	0	3 055	20 965	81 047	2 016	1 913
17	Pavlodar	Pavlodar	78	8	0	0	0	0	86	7 921	17 875	78 388	1 612	1 502	5 822	10 898	28 380	28	370	2 099	6 978	50 008	1 583	1 132
18	Pavlodar	Ekybastuz	24	4	0	0	0	0	28	2 569	5 797	25 423	523	487	1 896	3 548	9 240	9	120	673	2 249	16 183	513	367
19	Mangistau	Aktau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Mangistau	Zhanaozen	1	3	0	0	0	4	0	350	789	3 460	71	66	247	63	660	1	0	103	726	2 800	70	66
21	North Kazakhstan	Petropavlovsk	15	52	0	0	0	0	67	5 844	13 189	57 838	1 189	1 108	4 536	8 490	22 110	22	288	1 308	4 699	35 728	1 167	820
22	South Kazakhstan	Shymkent	61	109	0	0	0	170	0	14 993	33 835	148 373	3 051	2 843	10 491	2 693	28 050	56	0	4 502	31 142	120 323	2 995	2 843
23	South Kazakhstan	Turkestan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			1 788	995	0	0	0	953	1 830	251 070	566 603	2 484 694	51 087	47 604	182 703	246 993	761 145	918	7 875	68 367	319 610	1 723 549	50 169	39 729

Source: OECD CPT Programme OPTIC Model.

Emission reductions calculation

The emission reductions calculation module, under the tab “Emissions”, shows the estimated annual emission reduction by type of pollutant. This information is provided in an Excel table (as shown in Table B.12) that contains data on the main cities of Kazakhstan, the number of buses to be replaced, the type of new buses, the emissions from old buses, emissions from new buses, and emission reduction. In this module, users simply input the factual information without making decisions on the CPT Programme.

Programme costing and environmental effects

The CPT Programme costing and environmental effects module is under the tab “Decision” (as shown in Table B.13). This is the main module to support decision-making. It can be used for automatic calculation of the programme costs and also for manual adjustments.

Table B.13. **Adjusting programme costs and environmental effects**

Programme target	Costs			Emissions								
	Investment costs	100 000	Go	CO_2 (t/a)	10 500	Go	NOx (kg/a)	150 000	Go	SO_2 (kg/a)	5 000	Go
	Subsidy budget	10 000	Go	CO (kg/a)	60 000	Go	PM2.5 (kg/a)	45 000	Go			

Source: OECD CPT Programme OPTIC Model.

The upper part of the screen contains the information on the programme target. Users may define one of the following programme targets:

- investment costs;
- subsidy budget (amount of funding available for subsidies);
- CO_2 emission reduction;
- CO emission reduction;
- NO_x emission reduction;
- PM2.5 emission reduction;
- SO_2 emission reduction.

By clicking on the “Go” button to the right of the respective target, the model calculates the programme financial envelope necessary to achieve the target, for that target only, excluding the other targets.

The algorithm for the programme cost calculation is as follows:

- The model reviews the information on public transport for each city, in the order provided in the Table in the “Transport” tab. The review is done in four iterations, starting from the oldest buses (>15 years) and then respectively >10 years, > 5 years and 0-5 years.
- First, the model determines whether the city has any potential for CNG buses; if so, the model proposes the replacement of an old bus by a CNG bus.
- Then, the previous step is repeated until the target is reached or all old buses in a given iteration are replaced.

- If the city does not have the potential for CNG buses, the model completes the same steps with Euro VI diesel buses.
- If the city lacks the potential for either CNG or Euro VI buses, the model proceeds through the same steps with LPG buses.
- The costs of CNG stations are also taken into account. If the number of buses replaced is higher than 100, it is assumed that a CNG station is a commercial project and a subsidy is not required.

The results are presented in an Excel table (as shown in Table B.14) that contains basic information on the number of new buses, investment costs, subsidies and emission reductions per year. If users want to see details, the "Emissions" or "Costs" tabs should be used (described earlier).

Table B.14. **Relationship between programme costs and environmental effects**

			New buses			Investment costs	Subsidy	Emission reduction per year				
			Fuel									
No.	Region	City	Diesel	CNG	LPG	million KZT	million KZT	CO_2 (t)	CO (kg)	NO_x (kg)	PM 2.5 (kg)	SO_2 (kg)
1	Akmola	Kokshetau	0	0	127	4 077	1 955	2 670	9 335	69 599	2 251	1 590
2	Aktobe	Aktobe	0	75	0	3 193	1 823	1 837	13 402	51 607	1 291	1 226
3	Almaty (Region)	Taldykorgan	0	0	9	289	139	161	599	4 657	154	107
4	Astana City	Astana	0	0	227	7 288	3 495	4 905	16 986	125 721	4 050	2 867
5	Almaty City	Almaty	0	368	0	12 996	6 276	9 966	67 911	262 649	6 527	6 195
6	Atyrau	Atyrau	0	35	0	1 780	1 141	837	6 209	23 885	598	568
7	East Kazakhstan	Semey	0	0	82	2 633	1 262	1 813	6 228	45 820	1 471	1 043
8	East Kazakhstan	Ust-Kamenogorsk	0	0	276	8 861	4 249	6 511	21 889	158 279	5 036	3 590
9	Zhambyl	Taraz	0	77	0	3 263	1 857	1 942	13 886	53 537	1 337	1 269
10	West Kazakhstan	Uralsk	0	110	0	3 885	1 876	3 031	20 417	79 023	1 962	1 862
11	Karaganda	Karaganda	0	0	305	9 792	4 695	7 588	25 074	178 793	5 645	4 041
12	Karaganda	Temyrtau	0	0	18	578	277	394	1 359	10 020	322	228
13	Karaganda	Zhezkazgan	0	0	42	1 348	647	889	3 100	23 074	746	527
14	Kostanay	Kostanay	0	0	413	13 259	6 358	10 352	34 127	242 869	7 659	5 487
15	Kostanay	Rudniy	0	0	150	4 816	2 309	3 731	12 330	87 927	2 776	1 987
16	Kyzylorda	Kyzylorda	0	114	0	4 026	1 944	3 055	20 965	81 047	2 016	1 913
17	Pavlodar	Pavlodar	0	0	86	2 761	1 324	2 099	6 978	50 008	1 583	1 132
18	Pavlodar	Ekybastuz	0	0	28	899	431	673	2 249	16 183	513	367
19	Mangistau	Aktau	0	0	0	0	0	0	0	0	0	0
20	Mangistau	Zhanaozen	0	4	0	685	612	103	726	2 800	70	66
21	North Kazakhstan	Petropavlovsk	0	0	67	2 151	1 031	1 308	4 699	35 728	1 167	820
22	South Kazakhstan	Shymkent	0	170	0	6 003	2 899	4 502	31 142	120 323	2 995	2 843
23	South Kazakhstan	Turkestan	0	0	0	0	0	0	0	0	0	0
Total			0	953	1 830	94 581	46 602	68 367	319 610	1 723 549	50 169	39 729

Source: OECD CPT Programme OPTIC Model.

Users may change the project pipelines by providing their own information on the number of new buses. Then, the calculations are updated accordingly.

Programme costing for Phase 1 (pilot phase) and Phase 2 (scaling-up phase)

In the spreadsheet titled "Programme targets" (as shown in Table B.15) users may define whether the calculation is being done for the pilot phase (Phase 1), which covers only two cities, or for Phase 1 and 2. The user may also define whether normative or real emission factors are used in the calculation. The third parameter defined by the user is the scenario for Phase 2, which may be as follows:

- Scenario 1: Replacement of the oldest buses in Phase 2 (buses of more than 15 years old).
- Scenario 2: Replacement of buses of more than 10 years old and buses of more than 15 years old.

By clicking on the "Go" button to the right of the defined scenario, the model calculates the programme costs and emission reductions. The targets are thus ignored.

Table B.15. **Adjusting programme targets**

Phase		Emissions	norms	Scenario	2	Go

Source: OECD CPT Programme OPTIC Model.

Sources of information used in the assumptions

The current version of the model uses information from different sources, both Kazakh and international. This section describes the sources of information for each assumption used:

- **Data on urban public transport** (number of buses, fuel type and age) were provided by oblast Akimats of Kazakhstan, while some of the information comes from the Statistics Committee of the Ministry of National Economy of Kazakhstan, as well as from the Ministry of Internal Affairs.
- The **average prices of buses** were obtained from Daewoo Bus Kazakhstan; data on bus imports were taken from the Statistics Committee of the Ministry of National Economy, the State Revenue Committee of the Ministry of Finance (statistics on foreign trade activities) and the available data published by the Eurasian Economic Commission (EEC, 2015).
- The **price of the CNG station** was provided by KazTransGaz Onimderi LLP.
- The **fuel prices** were provided by the Statistics Committee of the Ministry of National Economy, KazTransGaz Onimderi LLP and the Information-Analytical Centre for Oil and Gas of the Ministry of Energy.
- **Fuel consumption** was calculated by reviewing technical information of bus producers and several bus utilities introducing new buses (*Der Betrieb mit Flüssiggas als Alternative zum Dieselantrieb*;[2] *Cost and Benefits of Clean Technologies for Bus Rapid Transit (BRT): Summary of Results for Kampala* (ICCT, 2012); *Comparison of Modern CNG, Diesel and Diesel Hybrid-Electric Transit Buses: Efficiency and Environmental Performance* (MJB&A, 2013); *CNG vs. Diesel Bus Comparison*;[3] *Infrastructure for Alternative Fuels* (European Expert Group on Future Transport Fuels, 2011) and *A Realistic View of CNG Vehicles in the US* (Nath et al., 2014).

Emission factors

The emission factors were taken from:

- the section on "Exhaust Emissions of European Monitoring and Evaluation Programme" (EMEP)/European Environment Agency (EEA) Air Pollution Emission Inventory Guidebook 2013; Technical Guidance to Prepare National Emission Inventories (EEA, 2013);
- Euro II-VI emission standards;
- Euro II-V fuel standards (for SO_2);
- the revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, Vol. 3: The Reference Manual (IPCC, 1996);
- The Emissions Factors Toolkit (EFT) published by Defra and the Devolved Administrations (Defra and the Devolved Administrations, 2017).

The various emission standards used in the calculations are provided in Table B.16. They are practically based on the European emission regulations for new heavy-duty diesel and bus engines, commonly referred to as Euro I-VI.

Table B.16. **EU emissions standards for heavy-duty diesel engines (g/kWh)**

Tier	Date	Test cycle	CO	HC	NO_x	PM
Euro I	1992 < 85 kW	ECE Regulation-49	4.5	1.1	8.0	0.612
	1992 > 85 kW		4.5	1.1	8.0	0.36
Euro II	October 1996		4.0	1.1	7.0	0.25
	October 1998		4.0	1.1	7.0	0.15
Euro III	*October 1999 Enhanced Environmentally friendly Vehicles (EEVs) only*	*European Stationary Cycle (ESC) and European Load Response (ELR)*	*1.0*	*0.25*	*2.0*	*0.02*
	October 2000	ESC and ELR	2.1	0.66	5.0	0.10-0.13
Euro IV	October 2005		1.5	0.46	3.5	0.02
Euro V	October 2008		1.5	0.46	2.0	0.02
Euro VI	31 December 2013		1.5	0.13	0.4	0.01

Source: EC (2017).

Similarly, the EU fuel standards of Euro II-V, used in the calculations, are provided in Table B.17.

Table B.17. **EU fuel standards**

Name	EU Directive	European Committee for Standardisation (CEN) Standard	Implementation date	Sulphur limit (ppm)
n/a	-	EN 590:1993 (d) EN 228:1993 (g)	October 1994	2 000
Euro II	93/12/EEC	-	October 1996	500 (diesel)
Euro III	93/12/EEC	EN 590:1999 (d) EN 228:1999 (g)	January 2000	350 (diesel); 150 (petrol)
Euro IV	98/70/EC	EN 590:2004 (d) EN 228:2004 (g)	January 2005	50
Euro V	2003/17/EC	EN 590:2009	January 2009	10

Source: EC (2017).

On the other hand, the estimated emission factors for a number of pollutants emitted by European heavy-duty diesel vehicles come from the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* and its *Reference Manual* (IPCC, 1996) as well as from the *EMEP/EEA Air Pollution Emission Inventory Guidebook 2013* (EEA, 2013).

Table B.18. **Estimated emission factors for European heavy-duty diesel vehicles**

	NO_x	CH_4	Non-methane volatile organic compound (NMVOC)	CO	N_2O	CO_2
Total g/km	10	0.06	1.9	9.0	0.03	770
g/kg fuel	42	0.2	8.0	36	0.1	3 140
g/MJ	1.0	0.006	0.2	0.9	0.003	74

Source: IPCC (1996), EEA (2013).

The *EME/EEA Air Pollution Emission Inventory Guidebook 2013* (EEA, 2013) is also used as a source for estimating the CO_2 emission factors for different fuels used in operating heavy-duty vehicles (Table B.19).

Table B.19. **CO_2 emission factor**

Fuel type	Heavy-duty vehicles
Diesel	3 180
CNG	2 750
LPG	3 017

Source: EEA (2013).

A couple of sources were used for fuel consumption values used in the model, as well as authors' own assumptions, particularly for LPG consumption volumes (Table B.20).

Table B.20. **Assumed fuel consumption**

Fuel type	g/km	kg/km	Source
Diesel	240	0.24	EEA (2013)
CNG	340	0.34	www.erdgasautos.at
LPG	340	0.34	Own assumption

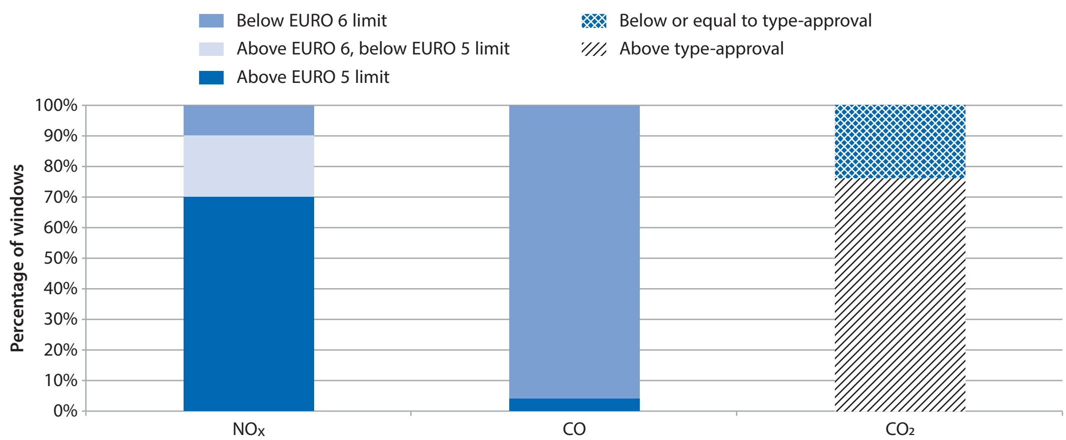
Source: OECD compilation.

For old engines, it was assumed that emission factors are the same as for a new one. However, the energy efficiency is higher and fuel consumption of a new engine is 10% lower than that of buses of more than 5 years old, 15% lower than buses of more than 10 years old and 25% lower than buses of more than 15 years old.

The specific emission factors used in the model are provided in Table B.2, at the beginning of the Annex section. The emission factors presented in Table B.2, however, are based on maximum levels, according to specific norms. The real emissions may vary, mainly because normative emissions are tested in laboratory conditions and not in actual traffic. This is a concern primarily in the case of diesel engines, where emission reduction depends on the installed emission reduction equipment. In the case of CNG and LPG, emissions are less problematic, because lower emissions are mainly the result of using cleaner fuels.

In 2014, the ICCT issued a report on real-world exhaust emissions from modern diesel cars presenting measurements of real emissions. The analysis showed that real-world emissions of CO_2 and NO_x are higher than the limits on average by 40% and 70%, respectively (Franco et al., 2014).

Figure B.1. **Percentage of tested vehicles that exceed Euro limits in urban cycle**



Source: Franco et al. (2014).

Note: The "window" represents a sample.

Thus, the model also offers an alternative set of emission factors taking into account the fact that real emissions may exceed normative ones. Table B.21 presents the real emission factors used in the model.

Table B.21. **Assumed emissions factors adjusted to real values (per km)**

Engine and fuel type	CO_2 (kg/km)	CO (g/km)	NO_x (g/km)	PM2.5 (g/km)	SO_2 (g/km)
Diesel Euro II	1.5137	2.4400	10.7000	0.2200	0.2050
Diesel Euro II>5 y	1.6650	2.6840	11.7700	0.2420	0.2255
Diesel Euro II>10 y	1.8164	2.9280	12.8400	0.2640	0.2460
Diesel Euro II>15 y	1.9678	3.1720	13.9100	0.2860	0.2665
Diesel Euro VI	1.0685	0.2230	4.2387	0.0023	0.0205
CNG (EEV standard)	0.9350	0.2400	2.5000	0.0050	0.0000
LPG	1.0258	1.9200	5.0000	0.0050	0.0652

Source: OECD CPT Programme OPTIC Model.

The user may change both normative and real emission factors according to the modelling needs.

Notes

1. The model assumes that an average bus operates 330 days per year.
2. See www.erdgasautos.at (accessed 20 February 2017).
3. See https://www.bus.man.eu/cng_optimizer/index.html (accessed 25 February 2017).

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Annex C

Example of a project application form

Bus replacement

Project Name					
Name of the project applicant					
Address					
Contact details					
Legal status					
Bank account number, bank, branch and address					
Location of the project (city)					
Description of the project:					
Number of buses used for regular services in the city (excluding inter-city lines)					
Number of bus lines operated by the company in the city (excluding inter-city lines)					
Planned bus replacement	Buses that will be replaced		New buses		
	Older than 15 years	10 to 15 years old	CNG	LPG	Diesel
Number of buses (#)					
Costs (KZT 1 000)	X	X			
Cost of CNG filling station if needed (KZT 1 000)	X	X			
Cost of other investments (maintenance station) (KZT 1 000)	X	X			
Total costs (KZT 1 000)	X	X			
Does the city plan investments to improve public transport? How will this improvement be achieved? Please describe all proposed measures and attach a plan prepared by the city.					
Are the proposed new buses longer than or equal to 10 metres? (yes/no)					
If CNG buses are proposed: Does a CNG filling station exist in the city?					
If a CNG filling station does not exist in the city: Is the city supplied with natural gas so a CNG filling station could be constructed?					
If modern diesel buses are proposed: Is clean (imported) diesel available in the city? (yes/no)					

Annex D

Example of a project pre-appraisal form

Bus replacement

Criteria	Yes/No
Criteria related to the location of the project	
Is the project located in the urban centre of the city listed in the list of eligible costs?	
Criteria related to the type of eligible projects	
Is the project type on the list of eligible projects?	
Are all the proposed project costs found in the list of eligible costs?	
Is the number of older buses (of between 10 and 15 and more than 15 years old) equal to new buses?	
If the proposal contains a plan to build a CNG filling station, is it accompanied by a replacement of old buses by new CNG buses?	
Criteria related to the type of eligible beneficiaries	
Is the type of beneficiary found on the list of eligible beneficiaries?	
Other eligibility criteria	
Are there existing plans for the city to implement additional investments that improve the urban public transport system in the city?	
Total: "Yes" if all answers are checked yes, "No" if at least one answer is no	

Annex E

Example of a project appraisal form

Measuring the environmental efficiency of an investment implies the calculation of the unit cost of decreasing, for example, PM2.5 emissions. The unit cost should be calculated as a difference between PM2.5 emissions from old diesel buses and from new buses. The calculation should use real emission factors from the model.

The best project receives 10 points, the worst 0 points; other projects receive points proportional to their position.

	Criteria	Weight	Max No. of points	Points
A	**Project preparation**	**0.1**		
1	Prepared business plan for project implementation in the city		0-1	
B	**Project location**	**0.2**		
1	Buses that will be replaced in polluted cities		5	
2	Buses that will be replaced are used only in the centre of the eligible city		5	
3	Buses that will be replaced are used in the city centre and on the outskirts/suburbs of the eligible city		3	
4	Buses that will be replaced are used in the city and connecting the rural area outside the eligible city		0	
C	**Project type**	**0.2**		
1	CNG-powered buses		10	
2	LPG-powered buses		5	
3	Modern diesel buses		1	
D	**Project size**	**0.2**		
1	More than 200 buses to be replaced		10	
2	Between 100 and 200 buses to be replaced		5	
3	Fewer than 100 buses to be replaced		1	
E	**Proposed system of improvements of urban public transport in the city:**	**0.1**		
1	Length of the new bus lanes (0 points < 2km, 1 p.– up to 2km, 2p. > 2km)		2	
2	Number of traffic lights with priority for public transport (0 points < 2, 1 p.– up to 4, 2p. > 5)		2	
3	Number of bus stops newly equipped with online information for passengers (0 points < 2, 1 p.– up to 4, 2p. > 5)		2	
4	Number of new bus stops (0 points < 2, 1 p.– up to 4, 2p. > 5)		2	
5	Other measures (points according to expert opinion)		2	
F	**Environmental efficiency**	**0.2**		
1	Unit efficiency	(F2-F3)/F4		
2	Calculated annual PM2.5 emissions from old buses [PM2.5 kg]			
3	Calculated annual PM2.5 emissions from new buses [PM2.5 kg]			
4	Project costs			
5	Points for environmental efficiency – the best project with unit efficiency U_{best} receives 10, the worst with unit efficiency U_{worst} receives 0, others with unit efficiency U receive $10*(U-U_{worst})/(U_{best}-U_{worst})$		10	
G	**Total: (weights × points)**			

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(97 2017 43 1 P) ISBN 978-92-64-27963-6 – 2017

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Promoting Clean Urban Public Transportation and Green Investment in Kazakhstan

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ISBN 978-92-64-27963-6
97 2017 43 1 P
9 789264 279636