DEVELOPMENT OF METHODOLOGY AND MODEL INTENDED FOR ASSESSMENT OF SOCIO-ECONOMIC IMPACT OF INVESTMENTS FINANCED FROM THE EUROPEAN UNION STRUCTURAL FUNDS AND THE NATIONAL BUDGET FUNDS OF LITHUANIA

FINAL REPORT

For:
The Ministry of Finance of the Republic of Lithuania
Public Institution the Central Project Management Agency

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Content

Introduction

The Ministry of Finance of the Republic of Lithuania and UAB "BGI Consulting" concluded agreement No. 14P-64 on August 10, 2012 for provision of the methodology and model creation service.

The aim formulated in the service technical assignment is to create a study-based methodology and model for assessment of the socio-economic impact of public sector investments financed from the EU Structural Funds and the Lithuanian National Budget. The methodology and the model must be designed only for the assessment of the socio-economic impact of public sector investments financed from the EU Structural Funds and the Lithuanian National Budget, when the investments are made into infrastructure, located in Lithuania. The methodology and the model must incorporate quantitative estimates of socio-economic impact (benefit and damage), assessments of financial project analysis of cash flow impact on the environment, quantitative assessment of indirect impact (if applicable), the factors needed for financial analysis cash flow recalculation into economic cash flows, as well as the calculation methodology of the listed indicators.

The service provider's activity results are presented in the presented final report, which may be divided into two main groups: 1) A set of conversion factors applicable for Lithuania, calculation methodology, application instructions; 2) Benefit (damage) components proposed for 13 sectors, estimates and arguments for choosing them, including a calculation methodology and application instructions.

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Abbreviations

HMHT – High and Medium High Technologies

GEV – General Economic Value

GDP – Gross Domestic Product

CAFE – program "Clean Air for Europe"

CH_4– methane

CO_2– carbon dioxide

COICOP – classification of individual consumption according to purpose

COST 313 – analysis of the "European Cooperation in Science and Technology" program on the socio-economic costs of road accidents

EIB – the European Investment Bank

EC – the European Commission

EC guidelines 2008 – the "Cost-Benefit Analysis of Investment Projects" prepared following the order of the European Commission

EQ-5D – a standardized tool for assessing health condition

EU – the European Union

OSCE – the Organization for Security and Co-operation in Europe

CEA – Classification of Economic Activities

CEA 2 – Classification of Economic Activities (Revision 2)

ExternE – the "External Costs of Energy" study

NPV – Net Present Value

VYL – Value of a Year of Life

GWP – Global Warming Potential

HDM-4 – the "Highway Development and Management" model

HEATCO – the Harmonised European Approaches for Transport Costing

LRMC – Long Run Marginal Costs

IRI – the International Roughness Index

IS – Information System

JAREP – the Electronic Service for Registration of Legal Entities

JASPERS – Joint Assistance to Support Projects in European Regions

USA – the United States of America

SP_{10} – solid particles with a diameter up to 10 µm

$SP_{2.5}$ – solid particles with a diameter up to 2.5 µm

CF – Conversion Factor

LCI – Life Cycle Inventory

FEZ – the Free Economic Zone

LRW – Lithuanian Railways

LR – the Republic of Lithuania

RDI – Research, Development and Innovation

NATO – the North Atlantic Treaty Organization

NEIS – the National Energy Independence Strategy

NH_3– ammonia

NMVOC – non-methane volatile organic compounds

NO_x– nitrogen oxides

O_3–ozone

PPP – Purchasing Power Parity

AV – Added Value

VAT – Value Added Tax

QALY – the Quality of Life Year index

RAIN – project "Rural Area Information Technology Broadband Network"

SDR – Social Discount Rate

SFMIS – the Computerized Reporting and Monitoring System for Structural Funds Assistance

SVL – Statistical Value of Life

SCF – Standard Conversion Factor

CBA – Cost-Benefit Analysis

CO_2 – sulphur dioxide

GHG – Greenhouse Gases

TEU – a measurement unit equal to twenty feet, used as a statistic traffic flow measure

IPCC – the Intergovernmental Panel on Climate Change

VOC – Vehicle Operation Costs

KTVV – kilometres travelled with a vehicle

IMF – the International Monetary Fund

PIAP – project "Public Internet Access Point Network Development"

AADTI – Average Annual Daily Traffic Intensity

ADTI – Average Daily Traffic Intensity

WFD – the Water Framework Directive

Concepts

Opportunity costs – the value of a resource when it used for the best alternative. The opportunity costs of a resource purchased is its market value in the financial analysis. The opportunity costs of a resource purchased is its marginal social value in the economic analysis if it would be used for the best alternative outside the project and if the resource is an intermediate product or service, or its usage value (measured by willingness to pay) if the resource is an end-user product or service.

Accounting price – the price representing the opportunity costs of goods, which sometimes differ from actual market prices or regulated rates. Accounting prices are used in the economic analysis in order to better reflect the actual costs of the resources and the benefit to society provided by the production. Accounting prices are often used as synonyms for shadow prices. Although the concept of shadow prices are used for representing the Drèze-Stern general balance problem solutions in this report, while the concept of accounting prices – for representing the estimate of shadow prices, identified by using methodological solutions.

Major element – an element with significant effect on the socio-economic impact indicators of a project. A major element is usually divided into main components, so that a border price could be applied to the tradable inputs – a standard conversion factor to the small scale non-tradable inputs, and for the rest of non-tradable inputs and production – a set of conversion factors for separate components.

Economic profit – profit, which differs from financial profit by the fact, that opportunity costs of resources used for performing activity are assessed when calculating economic profit.

Net present value – a value found by subtracting the discounted cost value from the discounted benefit value.

Long run marginal costs – costs of increasing the production of a certain goods by one additional unit. Such costs represent the social costs of one additional unit of the goods, by subtracting the social value of additional profit due to increased production. Because the short run marginal costs are usually inconsistent due to dependence on the level of production capacity, long run marginal values are considered more appropriate for determining the social value of goods.

Externality – any cots or benefit, exceeding the area covered by a project, i.e. emerge from the relationship margins between the producer and project beneficiaries or users of project services, and affects other parties without any monetary compensation. Such an external impact may be negative (e.g. level of pollution increased due to a new road) or positive (e.g. reduced congestion on an alternative road conditioned due to a new railway).

Commercialisation – transformation of innovative activity results to products sold in the market or other income.

Conversion factor – a factor used for adjusting monitored prices when they do not correspond to resources and actual social opportunity costs of production.

Minor element – an element of project costs with minimal effect on the socio-economic project impact indicators, because the part of it is irrelevant in the total project costs. Examples of such minor elements are other services and waste disposal, usually not amounting to a significant portion of total project costs.

Benefit (damage) component – a specific type of socio-economic impact (benefit or damage).

Benefit (damage) component estimate – a unit estimate for calculating the economic value (in Litas) of a benefit (damage) component.

Non-tradable goods – goods, which cannot be exported or imported (for example local services, non-qualified work, land). Non-tradable goods are usually assessed in the economic analysis according to their long run marginal costs when they are intermediate products or services, or by using the willingness to pay method when they are end-user products or services.

Border price – the price of a tradable good at the state "economic" border. It is – FOB (Free on Board) price in case of exported production and CIF (Cost, Insurance and Freight) price in case of imported resources.

Willingness to pay – the amount, which users are ready to pay for an end-user product or service.

Tradable goods – goods, which can be sold in the international market if no trade restrictions are applicable.

Project inflows – flows in the financial and economic analysis tables contributing to project returns.

Spin-off – a company found for commercializing innovation activity and RDI results.

Cost benefit analysis – a conceptual methodology applied in systemic quantitative assessment of public and private investment projects, which seeks to assess if (and what) value does an investment project have in the public point of view. The cost benefit analysis is different from a simple financial assessment because all costs and benefits for public agents are taken into account. Accounting prices (i.e. opportunity costs of goods, which sometimes differ from actual market prices or regulated rates) are usually used in the cost benefit analysis.

Social discount rate – a rate for discounting economic flows, i.e. the flows of economic benefit and economic costs analysed while performing an economic analysis. This rate reflects the social point of view of future value in comparison to the present.

Economic benefits and costs – the opportunity costs incurred or benefits gained by the whole economics system. These benefits and costs may differ from private benefits and costs, as well as this difference from the difference between monitored prices in the market and accounting prices.

Standart conversion factor – a conversion factor used for adjusting the market prices of minor elements.

Shadow price – the price representing the opportunity costs of goods, which may sometimes differ from actual market prices or regulated rates. Shadow prices are used for representing the Drèze-Stern general balance problem solutions, while the concept of accounting prices – for representing the estimate of shadow prices, identified by using methodological solutions.

Consumer surpulus – the difference between the prices a person (consumer) is ready to pay the price which he/she must pay.

I. Socio-Economic Benefit (Damage) Components

1.1. Health Care

1.1.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.1.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The socio-economic impact (benefit and damage) components were chosen on the basis of the approved general health care sector project type list (table **Error! Reference source not found.**).

Table 23. Distinguished types of general health care sector projects (as presented in the mid-term report)

Project type	Project examples
1. Investments into modernization and/or development of the public health care service infrastructure	1.1. Investments into renovation of premises, medical equipment, furniture, means of transport and communications, such as: - Infrastructure of outpatient services - Early diagnostics equipment of oncologic diseases 1.2. Modernization of inpatient psychiatric infrastructure
2. Investments into the RDI and study infrastructure of the health care sector	2.1. Centre of health technology 2.2. Infrastructure needed for the studies
3. Investments into the development of electronic health services	3.1. Creation of electronic health services

Source: compiled by "BGI Consulting" and "CSIL Milano" according to SFMIS, information of strategic planning documentation and information presented by the Ministry of Health of the Republic of Lithuania.

The main impact of investments into the infrastructure of the health care sector is changes in morbidity and mortality. The benefit of mortality changes involves reduction of mortality risk; however the positive changes in morbidity are associated with shortening the duration of a disease and reduction of the risk of falling ill.

The risk of mortality in the CBA of the health care sector performed in the USA, EU and many other countries in the world is determined based on the value of avoided deaths (i.e. the statistical value of life (SVL)) or the value of a year of life (VYL) preserved.

In the case of changes in morbidity, the most common approach is based on determining the economic value of shortening the duration of a disease or reducing of the risk of falling ill. Shortening the duration of a disease is assessed based on the medical costs incurred by a patient and the additional product created by the patient due to time saved for performing work. Reduction of morbidity indicators can be conditioned by:

- Improvement of existing diagnostics and/or disease prevention services for preventing morbidity or provision of new, similar services;
- Improvement of existing treatment services for improving the health condition of patients or provision of new, similar services.

The following typical estimates should be used for determining the changes in monetary mortality and morbidity value:

- Statistical value of life (SVL),
- Value of a year of life (VYL),
- Average daily income of a person.

Theoretical SVL and VYL assessment provisions are presented in Annex 2 of the Sector.

Investments into the health care sector may also create an impact, such as:

- Reduction of time costs needed to receive health care services,
- Increased efficiency.

Increased traffic congestion due to building new health care infrastructure (e.g. a hospital) and/or increased volume of health care services may condition indirect economic costs, such as:

- Increased air pollution,
- Increased emissions of greenhouse gases,
- Time costs.

A detailed reasoning of choosing the socio-economic impact components is presented in table 2. The benefit (damage) components applicable for specific project types are indicated in the table presented in Annex 1 of the Sector.

Table 14. Arguments for choosing the socio-economic impact (benefit and damage) components

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Statistical value of life	Direct impact	EC guidelines 2008 indicate, that the benefit of investments into health care infrastructure is primarily reflected in changes of morbidity and mortality. The benefit provided by decreased mortality is proposed to be assessed in the EC guidelines 2008 by using statistical value of life, representing the amount, which in the public point of view would be effective to be spent for the preservation of an unnamed person's life. Other available guidelines, such as the World Health Organisation guidelines[1], also propose to assess the direct impact on life through decrease in mortality and morbidity. Decreasing mortality and morbidity is also distinguished as one of the most important aims in the Social Investment Package[2] adopted by the European Commission in February, 2013 and it is a part of the "National Reform Agenda" of the Government of the Republic of Lithuania, in planning existing and planned structural reforms, in order to meet the quantitative goals of strategy "Europe 2020". Specifically, for one of the national aim – the reduction of social exclusion – Lithuania considers improvement of the availability and quality of health care services as a possible priority action in order to decrease morbidity and mortality from common non-infectious diseases. Improvement of the quality and availability of health care services is planned to be implemented by investing into the modernization of health care infrastructure and implementation of modern technologies[3]. Changes of mortality and morbidity are also distinguished as the biggest benefits[4] in the CBA of Lithuanian health care projects.
2. Value of a year of life	Direct impact	Arguments similar to the ones for the previous socio-economic impact component. In this case, the impact component represents a constant value attributed to the years of life lost due to premature death.
3. Value of a working day lost	Direct impact	Arguments similar to the ones for the previous socio-economic impact components. The benefit provided by decreased morbidity in the EC guidelines 2008 is proposed to be assessed based on the value of lost

[1] World Health Organisation (2006), *Guidelines for conducting cost–benefit analysis of household energy and health interventions.*

[2] European Commission (2013), Social Investment Package, Commission Staff Working Document: Investing in Health, SWD (2013) 43 final.

[3] The National Reform Agenda, approved by Decision of the Government of the Republic of Lithuania No. 491 "On the Lithuanian Convergence for 2011 program and the National Reform Agenda", dated April 27, 2011.

[4] For example, the economic analysis of project "The Reconstruction and Installation of VUL Santariškės Clinics Admission and Patient Rehabilitation Departments" (VP3-2.1-SAM-10-V-01-016) distinguishes reduction of patient mortality as a possible impact.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		product (not created when the patient or family members of the loose less working days). Other available guidelines propose to assess the benefit provided by decreased mortality and morbidity due to investments into health care according to the increase in employee income[5].
4. Reduction of time costs needed to receive health care services	Direct impact	This benefit consists of reduction of costs incurred by a patient in order to receive health care services. Such benefit occurs when infrastructure is created in a certain territory, thus increasing capacity or electronic health care services are started to be provided. Travel and queuing time (as well as direct monetary costs) are factors conditioning unequal access to health care services. Reduction of time costs (as well as monetary costs) needed in order to receive health care services is a usual aim of Lithuanian investments into the heath care sector[6] and it matches the EU aim to ensure equal availability of services provided and associated infrastructure at a local level (even in rural areas)[7].
5. Time costs due to increased traffic congestion	External impact on the environment	Increased capacity of health care services provided may condition an increase in traffic flows in the territory where the services are provided. This external impact is also mentioned in EC guidelines 2008. Costs associated with increased traffic congestion involve increased air pollution and emission of greenhouse gases, as well as time costs. In this case the damage component is for representing time costs.
6. Increased air pollution due to increased traffic congestion	External impact on the environment	Arguments similar to the ones of the previous damage component. In this case the estimate is for representing air pollution costs.
7. Increased emissions of greenhouse gases	External impact on the environment	Arguments similar to the ones of the previous damage component. In this case the estimate is for representing greenhouse gas emission costs.

Source: compiled by "BGI Consulting" and "CSIL Milano"

Increased efficiency of the health care services provided can be distinguished next to the benefit and damage component indicated in the table. This benefit occurs due to implementing new technologies for

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[5] For example, the Department of Finance and Administration (2006), *Handbook of Cost-Benefit Analysis.*

[6] For example, project "Fleet Renewal of Emergency Medical Assistance, Urgent Consultative Health Care and Primary Ambulatory Personal Health Care Vehicles" (VP3-2.1 – SAM-03-V-01-001) plans acquisition of vehicles needed for provision of mobile health care services in rural areas.

[7] European Commission (2013), *Report on health inequalities in the European Union*, Commission Staff Working Document, SWD (2013) 328 final.

increasing the efficiency of the services provided. Examples of this could be acquisition of new modern patient care and nursing equipment, computerization of workplaces, etc. There is not a unique estimate for calculating this benefit. Increased efficiency is usually reflected by reduced costs of the health care services provided (in comparison with a situation when the project would not be implemented) or an increased number of patients to whom the services were provided (by allocating the same amount of resources as in the situation when the project would not be implemented). Such information should be presented in the financial analysis of the project, i.e. increased efficiency is not proposed as a socio-economic benefit component.

1.1.3. Calculation Methodology and Application Instructions

1. Statistical value of life (SVL)

In economic literature the statistical value of life (SVL)[8] is defined as an amount, which in the public point of view would be effective to be spent for the preservation of an unnamed person's life[9].

Calculation methodology and calculated estimate value

An empirical analysis has shown that a certain consensus exists, that the best assessment method is to assess how much the public are ready to pay for reducing the risk mortality[10].

As described in Annex 2 of the Sector, various methods for calculating public willingness to pay for reducing mortality risk are created, varying from contingent valuation to transferring of benefit, from cost of a disease to the human capital approach. Every method has its flaws and advantages, the human capital approach is applied most commonly, thus it is proposed for Lithuania for this same reason. The principal of the method – in the public point of view an individual is worth the amount of products he/she would create during the rest of his/her life. According to this approach the SVL is defined as "*the discounted amount of an individual's future (marginal) contribution to the social product, where such contribution corresponds to future work income, with a simple condition, that earnings are equal to the value of the marginal product"*[11].

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[8] The "Statistical life" is used given the fact that the purpose of most safety measures is to reduce mortality risk, not to avoid specific deaths. See Abelson P. (2010), The Value of Life and Health for Public Policy, Macquarie University, http://www.appliedeconomics.com.au/pubs/papers/pa03_health.htm.

[9] See Björn Sund (2010), *Economic evaluation, value of life, stated preference methodology and determinants of risks*, Örebro Studies in Economics 21, Örebro University. OECD (2012), *Mortality Risk Valuation in Environment, Health and Transport Policies*, OECD Publishing. http://dx.doi.org/10.1787/9789264130807-en.

[10] See, for example, Viscusi, W. and Joseph E. Aldy (2003), *The value of a statistical life: a critical review of market estimates throughout the world*, Journal of Risk and Uncertainty, vol. 27(1), p. 5-76. Orley Ashenfelter (2006), Measuring the Value of a Statistical Life: Problems and Prospects, Discussion Paper Series No. 1911, Institute for the Study of Labor, Bonn, Germany.

[11] Björn Sund (2010), *Economic evaluation, value of life, stated preference methodology and determinants of risks*, Örebro Studies in Economics 21, Örebro University. OECD (2012), *Mortality Risk Valuation in Environment, Health and Transport Policies*, OECD Publishing. http://dx.doi.org/10.1787/9789264130807-en.

For the purposes of the human capital approach **the SVL calculated for Lithuania is 990,047 LTL.** Under theoretical provisions, the SVL was calculated by applying a 40 year time horizon. The calculations are based on a simple assumption corresponding to theoretical material, that the person at risk is 22 years old and can potentially contribute to the social community until he/she is 62 years of old (i.e. the average retirement age in Lithuania in 2013). The average gross income (incl. social insurance taxes) within a 40 year period is needed for the calculation. The income was assessed in accordance with the following indicators:

- The data of table *"M3060801: The Average Monthly Salary. Features: Sector, Year"* published in the indicator database of the Statistics Department of the Republic of Lithuania on the average gross income in 2012. In 2012 the value of the average monthly gross salary was 2,123.8 Lt, and the value of annual gross income, recalculated according to prices of 2013[12], (including the social taxes paid the employer) is equal to 35,049 Lt;
- The actual GDP forecast per capita of the Republic of Lithuania is presented in the website of the International Monetary Fund (IMF)[13]; the IMF forecast does not cover the entire horizon of the economic analysis, however, considering the uncertainty, it can be said that the annual growth rate for the remainder of the period is equal to the average of the forecast for the last five years, which in the year of calculation was 4.15%.

The SVL was calculated by adding the discounted value of work related income, which an individual expects to receive before retirement age (see formula 3 presented in Annex 2 of the Sector). The social discount rate of 6.15% is applicable for discounting in Lithuania.

Comparison to other countries. The statistical value of life (SVL) is determined by the income of residents, the value of SVL in the countries analysed (France, Germany, Italy, Spain and the United Kingdom) is much higher than the value calculated for Lithuania. For example, in 2011 the gross annual income in the United Kingdom was equal to 37,726 Euro[14], in comparison with the value of 35,049 LTL applied for Lithuania at prices of 2013, thus this difference would also be reflected in the calculated SVL value.

Application instructions

In order to assess the benefit of changes in mortality, the SVL is multiplied by the number of lives planed saved due to implementing the project. It should be noted that the proposed SVL value is calculated for a 22 year old person exposed to risk. If a project seeks to reduce the mortality risk of children or elderly people, it is advisable to calculate the SVL value for the group of the analysed age. Such SVL value can be calculated in accordance with the value of a year of life (VYL), representing a constant value, attributed to every year of life lost due to premature death. An example of calculating a specific (based on the value of a year of life) SVL value is presented in the estimate application instructions of the value of a year of life (see. insert 1).

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[12] According to the salary forecast by the Ministry of Finance of the Republic of Lithuania, see "Projections of Lithuanian Economic Indicators" (http://www.finmin.lt/web/finmin/aktualus_duomenys/makroekonomika).

[13] Source: http://www.imf.org/external/ns/cs.aspx?id=28 (in national currency).

[14] Indicator "[tps00175] - Average gross annual earnings in industry and services, by sex - Of full-time employees in enterprises with 10 or more employees (ECU/EUR)" published by Eurostat.

One of the advantages of using a specific (based on the value of a year of life) SVL value is the possibility of using this value with other health condition information of the individuals exposed to risk[15]. This can be performed by applying QALY (*quality of life year rating*) values. As indicated in Annex 2 of the Sector, the values of the QALY rating represent health condition. Weight is attributed to life expectancy, by taking quality factors into account, reflecting on the quality of life perceived by an individual, associated with the mentioned life expectancy. If lifespan was increased by one year, but the individual would suffer from pain and suffering, the value of the QALY rating would be low. A quality-adjusted value of SVL would be found by multiplying the QALY rating value by the SVL value. The value of the QALY index may range from 1 (perfect health) to 0 (death) or even negative values (if a person suffers severe pain and suffering). If an individual would have to spend the rest of his/her years blind or in a wheelchair, a value in the interval of 0-1 would be attributed to the additional years of life, in order to take this fact into account.

Estimate update instructions

The estimate value is recommended to be updated annually. The SVL value applicable to the first year of the CBA is calculated according to the previous instructions.

The applicable estimate values of the CBA for future years are increased by taking the actual GDP increase per capita into account (according to the forecasts of the International Monetary Fund[16]).

2. Value of a year of life (VYL)

In addition to the statistical value of life another important estimate, used for assessing benefit of decreased mortality, is the value of a year of life (VYL).

The value of a year of life (VYL) represents a constant value attributed to every year of life lost due to premature death[17]. I.e. VYL is used for assessing life expectancy changes.

Calculation methodology and calculated estimate value

The importance of the value of a year of life (VYL) estimate is based on arguments presented in scientific literature[18], that an individual able to live 40 years more will tend to value the rest of his/her life more in an immediate danger situation, that an older individual, who would be able to live, for example, 5 years. Calculating VYL creates the possibility to assess the SVL applicable to specific age groups (project target groups), as indicated in insert 1 below.

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[15] Pearce, D.W. and Howarth A. (2000), *Technical Report on Methodology: Cost Benefit Analysis and Policy Responses,* report prepared by RIVM, EFTEC, NTUA and IIASA in association with TME and TNO under contract with the Environment Directorate-General of the European Commission.

[16] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The IMF forecast does not cover the whole period of the economic analysis, thus considering arising uncertainties the annual increase rate for the remainder of the period is calculated according to the average of the annual GDP increase per capita forecast for the last five years.

[17] See, for example, Willinger, M. (2001), *Environmental Quality, Health and the Value of Life*, Policy Research Brief N.7.

[18] See, for example, OECD (2006), *Cost-Benefit Analysis and the Environment: Recent Developments*, prepared by Pearce D., Atkinson G., Mourato S., OECD Publishing; Viscusi W. and Joseph E. Aldy (2003), *The value of a statistical life: a critical review of market estimates throughout the world*, Journal of Risk and Uncertainty, vol. 27(1), p. 5-76.

Two VYL calculation procedures are presented in scientific literature. The first depends on the SVL value, which is converted into years of life values. The second procedure assesses the VYL according to results of contingent valuation studies. The VYL value applicable for Lithuania is calculated by using the first procedure. The VYL value was calculated based on the SVL value indicated above according to the formula presented in Annex 2 of the Sector, by using an age of 22 (for whom the SVL value was calculated) and a life expectancy of 73.98 years in the calculations[19]. **The VYL calculated for Lithuania is equal to:**

$$\mathbf{VYL = SVL/ [1+((1-(1+r)^{-(n-1)})/r)] = 60{,}060\ Lt,}$$

where SVL = 990,047 Lt; r means the discount rate (6.15%); n means the number of expected years of life (73.98 - 22 = 51.98).

Comparison to other countries. The value of a year of life (VYL) is determined by the income of residents, the value of VYL in the countries analysed (France, Germany, Italy, Spain and the United Kingdom) is much higher than the value calculated for Lithuania. For example, in 2011 the gross annual income in the United Kingdom was equal to 37,726 Euro[20], in comparison with the value of 35,049 LTL applied for Lithuania at prices of 2013, thus this difference would also be reflected in the VYL value calculated.

Application instructions

The value of a year of life value is needed for calculating the statistical value of life (SVL) value applicable to a specific age group. A calculation example of the SVL applicable to a specific age group is presented in insert 1.

[19] Data of 2012 (table "*M3010801: The Average Life Expectancy. Features: Administrative Theory, Sex*") published by the Statistics Department of the Republic of Lithuania.

[20] Indicator "[tps00175] - Average gross annual earnings in industry and services, by sex - Of full-time employees in enterprises with 10 or more employees (ECU/EUR)" published by Eurostat.

Insert 1. A calculation example of the statistical value of life (SVL) applicable to the 60 year age group

The calculation of SVL applicable to a specific age group is based on the VYL value. With a 60 year old target group and a life expectancy of 74 in Lithuania (data of 2012[21]), SVL (60) is calculated by using the following formula:

$$\text{Specific SVL (60)} = \text{VYL} * \sum_{t=0}^{T-a-1} 1/(1+r)^t$$

where T-a = 14 is the remaining expected lifespan, and *r* is the social discount rate.

After applying the social discount rate of 6.15% calculated for Lithuania, the SVL applicable for the 60 year old group is equal to:

60,060 LTL * 9.776 = 587,147 LTL

This value is multiplied by the number of lives (of the 60 year old group) planned to be saved due to implementing the project.

Source: compiled by "BGI Consulting" and "CSIL Milano"

The value of a year of life estimate allows assessing the benefit provided by prolonged lifespans of patients due to allocated investments. For example, if acquired equipment allows prolonging the lifespan of a certain group of patients by 5 years, the VYL estimate is attributed to every additional year of life. As mentioned in the application instructions of the statistical value of life, the important aspect is that the value of a year of life can be used with QALY (*quality of life year rating*) values. If lifespan was increased by one year, but the individual would suffer pain and suffering, the value of the QALY rating would be low. A quality-adjusted VYL value would be obtained by multiplying the QALY rating value by the VYL value. In this case, when calculating the SVL value, VYL is multiplied by the QALY rating in the formula presented in insert 1:

$$\text{Specific SVL} = \text{VYL} * \text{QALY} * \sum_{t=0}^{T-a-1} 1/(1+r)^t,$$

where the maximum value of the QALY rating is 1 (1 means the best possible health condition).

Estimate update instructions

The estimate value is recommended to be updated annually. The VYL value applicable to the first year of the CBA is calculated in accordance with previous instructions.

The applicable estimate values of the CBA for future years are increased by taking the actual GDP increase per capita into account (according to forecasts of the International Monetary Fund[22]).

[21] Table "*M3010801: The Average Life Expectancy. Features: Administrative theory, Sex*") published by the Statistics Department of the Republic of Lithuania.

[22] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The IMF forecast does not cover the whole period of the economic analysis, thus considering arising uncertainties the annual increase rate for the remainder of the period is calculated according to the average of the annual GDP increase per capita forecast for the last five years.

3. Value of a working day lost

The benefit provided by decreased morbidity in the EC guidelines 2008 is proposed to be assessed based on the value of lost product (not created when the patient or family members of the loose less working days).

Morbidity is defined as a fatal disease, manifesting in various symptoms. Acute and chronic morbidity is differentiated. Acute morbidity is defined as a short time disease with a clear beginning and end, usually lasting for a couple of days. Whereas chronic morbidity is considered to be long-time diseases (without a defined period).

Calculation methodology and calculated estimate value

Several methodologies for economic assessment of decreasing morbidity indicators are presented in scientific literature. The notable ones: cost of disease methodology, stated preferences (for example, contingent valuation) methodology and defensive behaviour methodology. The cost of disease methodology is mostly used for determining the social impact estimate of shortening the duration of a disease or avoiding the disease. According to this methodology, the general estimate includes direct and indirect costs[23]. Direct costs represent the opportunity costs of resources used for treating a certain disease. While indirect costs represent the value of a product not created because working time was shortened due to a certain disease.

Direct medical costs include treatment in hospital, outpatient treatment, emergency outpatient assistance, nursing at home or in the hospital, rehabilitative care, professional care, diagnostic tests, prescription medication, medical supplies and similar costs[24]. Such costs vary depending on the nature and severity of the disease and should be calculated for specific cases: in some cases health care costs may be huge, in others - amount to zero.

The human capital method[25] is mostly used for calculating the indirect costs of a disease. The last mentioned consists of the value of lost product (or lost income), calculated by multiplying the period of absence from work due to a certain illness by the salary of the ill employee. Indirect costs of a disease also include the value of household work, usually calculated as opportunity costs for manpower hired from the labour market to perform it.

In the case of children, disabled or elderly people, the working days lost by their relatives due to caring for them (or the monetary costs incurred due to paying other people for their care) should be considered to be an economic benefit estimate for decreasing the duration or risk of a disease.

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[23] World Health Organisation (2009), *Who Guide To Identifying The Economic Consequences Of Disease and Injury*, Department of Health Systems Financing Health Systems and Services, Switzerland.

[24] Joel E. Segel, (2006), *Cost-of-Illness Studies—A Primer,* RTI International RTI-UNC Center of Excellence in Health Promotion Economics.

[25] The willingness to pay method is mostly not considered to be adequate to assess costs of a disease. For example, surveys may not fully reveal the costs of contagious diseases due to external influence. People usually only consider their own costs, disregarding public benefit, i.e. the fact that reducing the number of people suffering from contagious diseases is beneficial for every member of the society, because the possibility of the disease spreading is reduced. More on the issue is presented by Joel E. Segel, (2006), *Cost-of-Illness Studies—A Primer,* RTI International RTI-UNC Center of Excellence in Health Promotion Economics.

A unit value estimate of a working day lost due to a disease is a proposed estimate for Lithuania. The proposed value is calculated by taking the average costs of an average one working hour[26] into account. Based on the salary growth rate[27], this value was recalculated to the values of 2013 and multiplied by 8 hours (assuming, that a working day consists of 8 hours). This way the value of a working day lost due to disease is equal to **165.92 LTL**.

Application instructions

Direct and indirect costs must be assessed in order to calculate the benefit provided by decreased morbidity.

Assessment of direct costs can be based on nationally available data on local treatment costs of more common diseases, such as diabetes, cardiovascular diseases, asthma, cancer, etc. The implementer of a project, intending to develop specific disease treatment or prevention capacity should know the size of such costs (the costs per patient presented in the financial analysis can also be used).

It is important to determine the number of days lost because of a specific disease in the assessment of indirect costs, this number is multiplied by the unit value estimate of a working day, presented above.

When performing the CBA it is advisable to differentiate projects for morbidity prevention and projects for improving the health condition of patients already sick (decreasing the duration of the disease). In the first case, the direct and indirect costs avoided due to implementing the project are considered a direct benefit. In the second case, improvement of the patient's condition can occur only as an increase in the product created by the patient, because treatment costs would not be avoided.

A calculation example is presented below.

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[26] Table "M3061113: Employee's average monthly costs and costs of one working hour by type of economic activity (EVRK 2) and company size groups" published by the Statistics Department of the Republic of Lithuania.

[27] The salary forecast is presented by the Ministry of Finance of the Republic of Lithuania; see "Projections of Lithuanian Economic Indicators" (http://www.finmin.lt/web/finmin/aktualus_duomenys/makroekonomika).

Insert 2. A calculation example of the benefit provided by reducing the risk of diabetes

Let's say a project for constructing a new diabetes control centre is analysed. This centre performs tests for determining patients with diabetes or the ones facing a high risk to develop it. Health insurance also covers tests and costs of the concomitant disease – glaucoma, associated with lifestyle changes and patients taking care of themselves, the changes are oriented towards prevention and reduction of developing diabetes comorbidities and diabetes complications.

Reduction of the number of people at risk to develop diabetes is distinguished a benefit of this project (preventive measures). Average direct and direct costs per patient are calculated in order to assess this benefit. According to the literature example, the direct annual costs per person with diabetes in Italy are 9,515.92 Lt, indirect – 18,518.06 LTL. Total costs (direct and indirect) sums up to 28,033.97 LTL. This value is multiplied by the number of patients benefiting from reducing the risk of diabetes. Let's say annually the number of such patients is 150. Therefore the annual benefit created by this project would be 4,205,096 LTL.

Source: compiled by "BGI Consulting" and "CSIL Milano"

In cases, when projects only improve the quality of life of patients (for examples, with long-term or chronic diseases) without increasing the value of the product created, the costs of a disease method may seem inadequate. In this case it is advisable to base the calculations on treatment costs (reflected by the price paid by the patients), as a willingness to pay for better quality of life estimate. The implementer of a project, intending to develop specific disease treatment capacity should know the size of such costs (price) (the costs per patient presented in the financial analysis can also be used).

Estimate update instructions

The estimate value is recommended to be updated annually. The value of a working day salary lost applicable during the first year of the CBA is calculated in accordance with previous instructions.

The applicable estimate values of the CBA for future years are increased by taking the actual GDP increase per capita into account (according to forecasts of the International Monetary Fund[28]).

4. Reduction of time costs needed to receive health care services

Construction of a new health care infrastructure, developing existing capacity and/or implementing electronic services may cause decreased time costs of patients in order to receive health care services. For example, new health care infrastructure in rural areas eliminates the need for local residents to travel 2 or 3 hours to the hospital located in the nearest town. Increasing the number of health care services provided can, in turn, reduce the waiting time of services users.

[28] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The IMF forecast does not cover the whole period of the economic analysis, thus considering arising uncertainties the annual increase rate for the remainder of the period is calculated according to the average of the annual GDP increase per capita forecast for the last five years.

All direct monetary costs, avoided by the patients or their relatives due to increased availability of health care services, such as accommodation in another city/town, costs of traveling abroad, etc. should also be considered in the analysis. The benefit is calculated separately for every individual case.

The decrease of time costs of patients seeking to receive health care services can represent both, working and non-working time. The "cost-saving" approach is usually used for assessing the value of working time. The main assumption of this approach is that the cost of the time wasted by an employee fall on the employer who could use the employee for alternative productive work. Whereas non-working time should be assessed by willingness to pay, revealing how people value their leisure time.

The time value calculations are almost the same as the ones indicated in the chapter for the transport sector, except that an adjustment factor is not applicable for the health care sector, reflecting the fact, that persons spending the most on transport also usually earn the most. Therefore the **value of working time** applicable to the health care sector**, when calculating according to prices of 2013, is equal to 19.30 LTL/h, non-working time** – **7.72 LTL/h.** These values are lower than the ones presented in the chapter for the transport sector because the users of the transport is the object of analysis in the case of the transport sector, and residents with higher income usually use transport more frequently. While health care services are used by all resident groups.

Application of the component and estimate for the health care sector

In order to calculate the benefit of saved time, the indicated unit values above are multiplied by the number of hours planned to be saved (working and non-working hours separately). The benefit value over a certain year is found due to decreased time costs, incurred by seeking to receive health care services.

5. Time costs due to increased traffic congestion

Improved provision of health care services may condition increased traffic flows in the territory where the services are provided. This causes additional costs, including time costs.

This socio-economic impact component and its estimates are the same as indicated in the chapter for the transport sector.

Application of the component and the estimate for the health care sector

Estimate application instructions are similar to the ones indicated in the chapter for the transport sector.

In order to calculate time costs due to increased traffic congestion, the value of time for traveling passengers should be applied to the passengers, not the vehicles they travel in. If available traffic flow information only involves vehicles, it should be converted to the number of passengers, by applying the average number of passengers traveling in one vehicle, which in the case of Lithuania is 1.2 passengers per vehicle[29].

Impact on traffic congestion should be assessed in the opportunity study of a specific project.

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[29] According to data of the Public Institution Transport and Road Research Institute.

6. Increased air pollution due to increased traffic congestion

Another element of additional costs caused by increased traffic congestion is air pollution costs.

This socio-economic impact component and its estimates are the same as indicated in the chapter for the transport sector.

Application of the component and estimate for the health care sector

Estimate application instructions are similar to the ones indicated in the chapter for the transport sector.

The impact of the project on the emission of various pollutants according to modelling results should be described in the opportunity study. Usually the impact on pollution can be found in the project environmental impact assessment report. These amounts should be multiplied by unit estimates, therefore finding the monetary value of the impact.

7. Increased emissions of greenhouse gases due to increased traffic congestion

The last element of additional costs caused by increased traffic congestion is the costs of increased emissions of greenhouse gases. Greenhouse gases (GHG) have a long-lasting impact of various types which is difficult to assess.

This socio-economic impact component and its estimates are the same as indicated in the chapters for the transport and energy sectors.

Application of the component and estimate for the health care sector

Estimate application instructions are similar to the ones indicated in the chapters for the transport and energy sectors.

The impact of the project on the emission of various pollutants and GHG according to modelling results should be described in the opportunity study. Usually the impact on the amount of CO_2 can be found in the project environmental impact assessment report. This amount should be multiplied by unit the estimate, therefore finding the monetary value of the impact.

1.1.4. The Socio-Economic Impact Table of the Health Care Sector

In summary, the socio-economic impact estimates are presented in the technical assignment set out in the form of a table (table **Error! Reference source not found.**). According to the requirements of the technical assignment, the indicator table must be associated with the conversion factors set by the service provider in order to ensure that there is no double-counting of benefit and damage.

Table 25. The socio-economic impact estimates established for the health care sector

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload	Quantitative expression, Lt
Health Care	N/a	The estimate is not associated with the set conversion factors applicable to the costs; therefore there is not risk of double-counting benefits and damages.	1. Statistical value of life (SVL)	990,047 LTL for one saved life at prices of 2013.
Health Care	N/a	The estimate is not associated with the set conversion factors applicable to the costs; therefore there is not risk of double-counting benefits and damages.	2. Value of a year of life (VYL)	60,060 LTL at prices of 2013.
Health Care	N/a	The estimate is not associated with the set conversion factors applicable to the costs; therefore there is not risk of double-counting benefits and damages.	3. Value of a working day lost	165.92 LTL per day at prices of 2013.
Health Care	N/a	The estimate is not associated with the set conversion factors applicable to the costs; therefore there is not risk of double-counting benefits and damages.	4. Reduction of time costs needed to receive health care services (value of working and non-working time)	The value of working time is **19.30 LTL/h** at prices of 2013. The value of non-working time is **7.72 LTL/h** at prices of 2013.

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload</th><th>Quantitative expression, Lt</th></tr>
<tr><td>Health Care</td><td>N/a</td><td>The estimate is not associated with the set conversion factors applicable to the costs; therefore there is not risk of double-counting benefits and damages.</td><td>5. Time costs due to increased traffic congestion</td><td>29.33 LTL per hour for passengers traveling on business at prices of 2013;
11.73 LTL per hour for passengers not traveling on business at prices of 2013;
11.35 LTL per hour for one tone of cargo transported at prices of 2013.</td></tr>
<tr><td>Health Care</td><td>N/a</td><td>N/a</td><td>6. Increased air pollution due to increased traffic congestion</td><td>In LTL for one tone of pollutants emitted:
NOx – 15,638;
NMVOC – 1,738;
SO_2 – 20,850;
SP2.5:
City – 1,243,209;
Town – 403,978;
Village – 248,468;
SP10:
City – 496,936;
Town – 161,591;
Village – 99,040.</td></tr>
<tr><td>Health Care</td><td>Energy</td><td>Fuel excise duties are aimed to reflect the negative impact of climate change. Since the conversion rates applicable for energy eliminate these duties, the estimate for calculating greenhouse gases, does not create a risk of double-counting benefits and damages.</td><td>7. Increased emissions of greenhouse gases due to increased traffic congestion</td><td>In LTL for one tone of CO_2:
<table>
<tr><th rowspan="2">Application year</th><th colspan="3">Central value</th></tr>
<tr><th>Lower value</th><th>Central value</th><th>Upper value</th></tr>
<tr><td>2010-2019</td><td>28</td><td>86</td><td>169</td></tr>
<tr><td>2020-2029</td><td>59</td><td>138</td><td>242</td></tr>
<tr><td>2030-2039</td><td>76</td><td>190</td><td>345</td></tr>
<tr><td>2040-2049</td><td>76</td><td>242</td><td>466</td></tr>
<tr><td>≤2050</td><td>69</td><td>293</td><td>622</td></tr>
</table></td></tr>
</table>

Notes:

*The indicator table must be associated with the conversion factors set by the service provider in order to ensure that there is no double-counting of benefit and damage.

1.1.5. Annexes (Health Care Sector)

Annex 1. The benefit (damage) components applicable to different project types

Project type	Applicable benefit (damage) components
1. Investments into modernization and/or development of the public health care service infrastructure	1. Statistical value of life (SVL) 2. Value of a year of life (VYL) 3. Value of a working day lost 4. Reduction of time costs needed to receive health care services 5. Time costs due to increased traffic congestion 6. Increased air pollution due to increased traffic congestion 7. Increased emissions of greenhouse gases due to increased traffic congestion
2. Investments into the RDI and study infrastructure of the health care sector	1. Statistical value of life (SVL) (if the results are conveyed to patients) 2. Value of a year of life (VYL) (if the results are conveyed to patients) 3. Value of a working day lost (if the results are conveyed to patients)
3. Investments into the development of electronic health care services	4. Reduction of time costs needed to receive health care services

Source: compiled by "BGI Consulting" and "CSIL Milano"

Annex 2. SVL, VYL and QALY – reasoning presented in theory

The statistical value of life (SVL) estimate is being increasingly included in the analysis of project impact on mortality. The last mentioned demonstrates the monetary value attributed by the public for decreasing the average number of death by one unit[30]. Calculating the SVL means to assess the proportion by which people are determined to change their income into decreasing mortality risk. According to the standard model, the SVL may be expressed in a formula:

$$SGV = \frac{dW}{dp} = 1 = \frac{u_a(W) - u_d(W)}{(1-p).u'_a(W) + p.u'_d(W)} \tag{1}$$

In this formula W means wealth, p – current probability of death (initial risk), (1 - p) – current probability of survival, u – utility, a – survival, d – death.

According to this formula, the SVL is expressed as a proportion between the benefits of survival and death indicated in the numerator currently and the marginal value of wealth indicated in the denominator (usually empirically calculated as income) in case of survival or death.

In practice the SVL is calculated by assessing the willingness to pay for decreasing mortality risk by individuals, not by using fluxions. Various methods can be used for calculating willingness to pay, they are presented below. However, despite some conceptualization problems (presented further), perhaps the most widely used is the human capital method[31].

[30] Australian Government (2008), *Value of statistical life: Best Practice Regulation, Guidance Note*, Department of Finance and Administration.

[31] Steven Landefeld, J. and Seskin, E., (1982) The Economic Value of Life: Linking Theory to Practice, AJPH June 1982, Vol. 72, No. 6.

Insert 1. Methods for calculating the value of human life

Usually the following methods are used for determining the value of human life:

1. **The stated preferences method**. The estimates are found by performing contingent surveys, where individuals are asked how much they are willing to pay for a certain benefit or reduction of risk associated with health. In recent years, researchers have introduced choice modelling methods, according to which, individuals were asked if they would be willing to pay more for a certain choice. The contingent valuation restriction is conditioned by the fact that respondents may improperly perceive the changes in risk or value generalized benefits (new health care infrastructure), not the quantitative decrease in risk. Moreover, according to theoretical literature, willingness to pay surveys tend to overestimate willingness to pay and does not correspond to actual choices of the users, which are limited by budget[32].

2. **Hedonic salary studies.** According to this methodology it is assumed that employees are willing to give a part of their income for better workplace safety or demand higher salaries for work with higher risk (or accept higher risk for higher salaries). The salaries-risk method is based on the assumption that employees understand the difference of risk (sometimes very small), which is differentiated in the model between (often correlating with each other) benefits for fatal and non-fatal accidents.

3. **Avoidance behaviour methods.** The economic value of willingness to pay for reduced risk may be approximately determined according to the costs incurred by an individual for reducing the risk. Two method types are possible: i) *the defensive behaviour method*, under which it is monitored how much users pay for products to reduce mortality risk or injury; ii) *the costs of a disease* method, under which the costs for reducing mortality risk or injury are assessed. This method is different from the defensive behaviour method because in the event of a disease not only the person, but also for social affairs officials, politicians and taxpayers contribute to the decision on his/her health care costs.

4. **Adapted transfer of benefit.** The SVL calculated in country A can be transferred to country B. In order to do so, the estimate is multiplied by the ratio between the income per capita in country B and income per capita in country A. Formula: $SVL_B = SVL_A * (Y_B / Y_A)^{\varepsilon}$, where Y means the income per capita, and Ɛ – SVL income elasticity. In the simplest case of applying this method it is assumed, that SVL income elasticity is equal to 1, which means that the ratio between the SVL and the income per capita are the same[33].

5. **The human capital method[34]** (lost income). Avoided deaths are assessed based on discounted income, which a person would have earned if he/she would have survived.

Source: compiled by "BGI Consulting" and "CSIL Milano"

According to the human capital method, SVL is calculated according to the following formula[35]:

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[32] Australian Government (2008), *Value of statistical life: Best Practice Regulation, Guidance Note*, Department of Finance and Administration.

[33] For more information on the formula see: Maureen L. Cropper Sebnem Sahin (2009), Valuing Mortality and Morbidity in the Context of Disaster Risks, Policy Research Working Parer 4832, The World Bank - Development Research Group Sustainable Rural and Urban Development Team.

[34] Pearce, D.W. and Howarth A. (2000), Technical Report on Methodology: Cost Benefit Analysis and Policy Responses, report prepared by RIVM, EFTEC, NTUA and IIASA in association with TME and TNO under contract with the Environment Directorate-General of the European Commission

$$\text{SVL} = \Sigma_{i=0,T-t-1}\,(p_{t+1}\,Y_{t+1})/(1+r)^{i} \qquad (2)$$

where $\Sigma_{i=0,\ T-t-1}$ means adding throughout the period starting from time t (the current age of the person at risk), T – age, after which the person stops working, P_{t+i} – the survival probability of a person from age t to age t+i, Y – income, r – discount rate.

A simplified SVL calculation formula is presented below:

$$\text{SLV} = \sum_{t}^{T} \frac{L_t}{(1+i)^t} \qquad (3)$$

where means the remainder of a person's life, L_t – income from work, i – social discount rate. The SVL value applicable for Lithuania is calculated based on the simplified formula.

According to theoretical provisions, SVL usually represents the life of a young adult with at least 40 years of life left[36].

Although the human capital method is accepted universally, it has certain flaws. First of all, it is concentrated only on working residents, ignoring the value of life of children, elderly people and people not participating in the labour market (e.g. housewives). It could be argued that the representatives of the latter group are potential employees and are able to receive income.

Calculating the **value of a year of life (VYL)** is one of the ways to determine the value or reducing mortality risk of elderly people, young people not participating in the labour market and children. VYL is usually considered an annual amount, attributed to each year of life left of the person at risk. SVL is found by discounting the flow of such annual amounts. SVL is calculated under the following formula[37]:

$$GMV = \frac{SGV}{A} \qquad (4)$$

where A=A(n, r) = $\sum_{t=0}^{n-1} \frac{1}{(1+r)^t}$ $\;arba\; A = 1 + [1-(1+r)^{-(n-1)}]/r$

n means the number of expected years of life, t – years, and r – discount rate.

A specific SVL value for a specific age group can be found by applying VYL, by using the following formula:

$$\text{SVL(a)=VYL}*\sum_{t=0}^{T-a-1} 1/(1+r)^t \qquad (5)$$

where a means the age of the person or group at risk, T – life expectancy of this person or group, t – years, and r – social discount rate.

The relation between SVL and age is a matter widely discussed in theoretical literature. Theoretical studies based on life consumption patterns observe that SVL is increasing up to an age of 40, then starts to

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[35] Pearce, D.W. and Howarth A. (2000), Technical Report on Methodology: Cost Benefit Analysis and Policy Responses, report prepared by RIVM, EFTEC, NTUA and IIASA in association with TME and TNO under contract with the Environment Directorate-General of the European Commission.

[36] As indicated in, for example, Abelson P. (2008), *Establishing a Monetary Value for Lives Saved: Issues and Controversies, WP 2008-02 in cost-benefit analysis*, Office of Best Practice Regulation, Department of Finance and Deregulation, Sydney University.

[37] Abelson P. (2010), *The Value of Life and Health for Public Policy*, Macquarie University, http://www.appliedeconomics.com.au/pubs/papers/pa03_health.htm.

decrease (the relation between SVL and age can be visualized by a curve in the form of an inverted U), in other words, SVL decreases with age[38].

The second flaw of the human capital method is the fact, that it ignores other dimensions of health, such as pain and suffering. Assessment of a patient's health care condition may be based on the values of **QALY (*quality of life year rating*).** According to the theoretical provisions of QALY, the result of treatment and other services with impact on health can be longer life of the patients, although the life may not be wholesome. For example a project for implementing new technologies can increase the life of patients by 6 years and reduce the mortality risk, but his/her condition may remain critical (e.g. frequent pain, physical weaknesses). The QALY rating helps assess the quality of the remaining years of life. Various methods are used for life quality assessment, the so-called health performance, for example, the standard gambling method, the time exchange method or the rating scale method. The calculated performance represents a health condition in the interval from 0 to 1, where 0 means death, and 1 – the best possible health condition, however, some health conditions are considered worse than death, so they can have negative values[39]. One of the tools presenting a set of health performance values is EQ-5D (presented below).

EQ-5D[40] health condition assessment

Health condition	Description	Assessment
11111	No problem.	1.000
11221	No trouble walking; no trouble taking care of oneself; little trouble engaging in usual activities; little pain and discomfort; no anxiety or depression.	0.760
22222	Little trouble walking; little trouble washing up or dressing up; little trouble engaging in usual activities; average pain and discomfort; little anxiety or depression.	0.516
12321	No trouble walking; no trouble taking washing up or dressing up; inability to engage in usual activities; little pain and discomfort; no anxiety or depression.	0.329
21123	Little trouble walking; no trouble taking care of oneself; no trouble engaging in usual activities; average pain and discomfort; severe anxiety or depression.	0.222
23322	Little trouble walking; inability wash up or dress up; inability to engage in usual activities; average pain and discomfort; average anxiety or depression.	0.079
33332	Bedridden; inability wash up or dress up; inability to engage in usual activities; severe pain and discomfort; average anxiety or depression.	-0.429

[38] As indicated in, for example, Joseph E. Aldy W. Kip Viscusi (2004), Age Variations in Workers' Value of a Statistical Life, Discussion Paper No. 468, Harvard Law School Cambridge, MA 02138.

[39] For example, health condition "bedridden; inability wash up or dress up; inability to engage in usual activities; severe pain and discomfort; average anxiety or depression".

[40] It is a standard tool for assessing health condition (http://www.euroqol.org).

Source: Phillips C., Thompson G. (2009), What is a QALY, in What is…? Series, Second Edition, Volume 1 N.6, Health economics.

1.2. Social Security

1.2.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.2.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The socio-economic impact (benefit and damage) components were chosen on the basis of the approved general social security sector project type list (table **Error! Reference source not found.**).

Table 26. Distinguished types of general social security sector projects

Project type	Project examples
1. Investments in necessary infrastructure for customer service	1.1. Investments in the infrastructure needed for providing service to job seekers and employers (it is planned to finance only the infrastructure of the Lithuanian Labour Exchange / territorial labour exchanges)
2. Investments in development of a stationary social service infrastructure	2.1. Investments in development of a children's stationary social service infrastructure (*for example, modernization of stationary social care institutions)* 2.2. Investments in development of a stationary social service infrastructure for adults with disabilities 2.3. Investments in development of a stationary social service infrastructure for elderly people
3. Investments in development of a non-stationary social service infrastructure	3.1. Investments in development of a children's non-stationary social service infrastructure (*for example, establishment of social day care centres)* 3.2. Investments in development of a non-stationary social service infrastructure for adults with disabilities 3.3. Investments in development of a non-stationary social service infrastructure for adults in social risk (*for example, establishment of psychosocial rehabilitation centres*) 3.4. Investments in development of a non-stationary social service infrastructure for elderly people (*for example, establishment of independent living homes*) 3.5. Investments in development of a non-stationary social service infrastructure for families in social risk (*for example, establishment*

Project type	Project examples
	of family support services)
4. Development of social housing	4.1. Investments in development of social housing

Source: compiled by "BGI Consulting" and "CSIL Milano" according to SFMIS, information of strategic planning documentation and information presented by the Minister of Social Security and Labour of the Republic of Lithuania.

Provisions associated with the social security sector are not presented in EC guidelines 2008, although the United Kingdom[41] has significant methodological experience in this sector. Increase in income (the product created) is distinguished as the main direct impact of social security sector programs in the literature of this country. In fact the 1st type of projects (investments in necessary infrastructure for customer service) will create conditions for providing better service to job seekers and employers, therefore such investments will contribute to the employment of such persons and increase their income (product created). 2nd and 3rd types of projects (investments in development of stationary and non-stationary social service infrastructure) create possibilities for persons taking care of elderly people, persons in social risk and children, and therefore for the incapable of working to get back into the labour market, i.e. such investments create conditions for avoiding loss of the product created.

Although investments in development of social housing (4th type), according to studies performed abroad[42] and an empirical cost benefit analysis performed in Lithuania[43], increase the possibilities of procuring housing for vulnerable social groups.

The methodological literature of the United Kingdom also analyses the indirect effect of social security sector programs, which could occur through:

- The multiplicator effect, representing the incentive impact on the economy by the costs incurred due to implementing a project and increased income (as well as the cost) of project target groups. I.e. during implementation, the implementer of a project pays the private sector for the works performed, thus creating and incentive impact on the economy (construction materials are purchased, salaries are paid to employees, who, in turn, increase consumption). Because the infrastructure created creates possibilities for persons taking care of elderly people, persons in social risk and children, and therefore for the incapable of working to get back into the labour market, income and consumption of such people increases, i.e. more services and goods are purchased, thus having an incentive impact on the economy. However both, the United Kingdom methodical documents and EC guidelines 2008 recommend not to assess the multiplicator effect, because the scope cannot be estimated precisely enough, and the impact on primary markets must be significant enough in order to create and effect in secondary markets;

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[41] For example, The Department for Work and Pensions (2010), "Social Cost-Benefit Analysis framework. Methodologies for estimating and incorporating the wider social and economic impacts of work in Cost-Benefit Analysis of employment programmes", Working Paper No. 86.

[42] For example, Fujiwara, D. (2013) "The social impact of housing providers", London: Housing Associations' Charitable Trust.

[43] For example, A Feasibility Study of Šiauliai City Social Housing Construction and Operation, 2011 m.; a feasibility study by means of public and private sector partnership of project "Social Housing Development in Marijampolė Municipality", 2011.

- Improved health, because it is scientifically proven, that employment improves health condition, because it gives the opportunity to have experiences important for health, such as structured use of time, activity, social contacts, collective aims and status[44]. Methodological literature recommends assessing this benefit by health care costs saved[45];
- Decreased crime rate, because it was noticed, that the probability of a person to commit theft or robbery in order to obtain money decreases after he/she becomes employed. However, such a benefit is not likely in the case of investments analysed, because the relevant target group is persons taking care of elderly people, persons in social risk and children. I.e. these persons, engaged in care activities, likely have neither the time nor the incentive to commit theft or robbery.

A detailed reasoning of choosing the socio-economic impact components is presented below (table **Error! Reference source not found.**).

Table 27. Arguments for choosing the socio-economic impact (benefit and damage) components

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Job / Employee search time economy	Direct impact	Such impact is typical for investments in necessary infrastructure for customer service, which creates conditions for providing better service to job seekers and employers, therefore reducing the search time. At the same time, finding a job faster increases the income (product created) of the job seeker, this is a typical impact of investments in the social security sector, proposed in foreign methodological documents[46] and practically assessed in the empirical cost benefit analysis. This benefit corresponds to both, EU and National strategic documents (e.g., the number of residents, exposed to the risk of poverty / material poverty / living in households of unemployed people or people with very low employment is provided as an assessment criterion in the National Progress Program of 2014–2020). Furthermore, job / employee search economy does not only mean faster employment, but also time saved by the job seekers and employer representatives.
2. Increased availability of care services	Direct impact	This is a typical impact of investments in the social security sector reflecting the costs avoided the person providing care and not participating in the labour market (when the person who takes care of the person requiring care comes back to the labour market) or avoided care costs (when other people were hired to perform the care). This

[44] Jahoda, M. (1982). Employment and Unemployment: A Social-Psychological Analysis. Cambridge University Press.

[45] For example, The Department for Work and Pensions (2010), “Social Cost-Benefit Analysis framework. Methodologies for estimating and incorporating the wider social and economic impacts of work in Cost-Benefit Analysis of employment programmes”, Working Paper No. 86.

[46] For example, The Department for Work and Pensions (2010), “Social Cost-Benefit Analysis framework. Methodologies for estimating and incorporating the wider social and economic impacts of work in Cost-Benefit Analysis of employment programmes”, Working Paper No. 86.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		benefit, which also reflects on the income increase in the persons receiving the benefit, corresponds to both, EU and National strategic documents (e.g., the number of residents, exposed to the risk of poverty / material poverty / living in households of unemployed people or people with very low employment is provided as an assessment criterion in the National Progress Program of 2014–2020).
3. Benefit provided by improved health of employed persons	Indirect impact	It is scientifically proven, that employment improves health condition, because it gives the opportunity to have experiences important for health. Thus, for example, in the United Kingdom, the benefit provided by improved health of employed persons is considered a benefit provided by social security programs, this benefit occurs as reduced costs of the national health care system. Similarly, this benefit is proposed to be assessed in the case of Lithuania.
4. Increased possibilities of socially vulnerable persons to get housing	Direct impact	Increased possibility of socially vulnerable persons to get housing is a typical benefit provided by investment in development of social housing. Such benefit is distinguished by both, studies performed abroad[47] and an empirical cost benefit analysis performed in Lithuania[48]. This benefit corresponds to both, EU and National strategic documents (e.g., increasing housing availability for vulnerable groups is provided as an assessment criterion in the National Progress Program of 2014–2020).

Source: compiled by "BGI Consulting" and "CSIL Milano"

Attributing of benefit (damage) components for specific project types is presented in Annex 1 of the Sector.

1.2.3. Calculation Methodology and Application Instructions

1. Job / Employee search time economy

Job search time economy is typical for investments in necessary customer service infrastructure, which creates conditions for providing better service to job seekers and employers, therefore reducing the search time. At the same time, finding a job faster increases the income of the job seeker. Furthermore, job / employee search time economy also means time saved by the job seekers and employer representatives.

[47] For example, Fujiwara, D. (2013) “The social impact of housing providers”, London: Housing Associations’ Charitable Trust.

[48] For example, A Feasibility Study of Šiauliai City Social Housing Construction and Operation, 2011; a feasibility study by means of public and private sector partnership of project "Social Housing Development in Marijampolė Municipality", 2011.

Calculation methodology and calculated estimate value

Increase in income (the product created) is distinguished as the main direct impact of social security sector programs in the methodical documents of the United Kingdom. Employment of persons allows avoiding the costs borne by the public due to loss of products created. The avoided public costs due to loss of the products created are equal to the gross income of the employed person (including social contributions by the employer) expressed by shadow price.

Very often the unemployed person employed faster will receive minimum salary due to faster service for job seekers and employers. Currently, the minimum monthly salary (MMS) is equal to 1,000 LTL. After adding the social contributions paid by the employer, amounting to 31.2%, the salary is:

$$1{,}000 \text{ LTL} * (1 + 0.312) = 1{,}312 \text{ LTL / month.}$$

After applying the conversion rate for non-qualified work, the shadow minimum salary is:

$$1{,}312 \text{ LTL} * 0.888 = 1{,}165 \text{ LTL / month.}$$

According to compiled historical documents the implementer of a project can prove, that due to faster service for job seekers and employers, unemployed persons employed faster will get higher average salaries than minimum salaries. In this case a more suitable estimate value should be used. This value is found by recalculating the average gross salaries (including social contributions by the employer) of unemployed persons employed faster to a shadow price[49].

Job search time economy also means **time saved by the job seekers and employer representatives.** It is appropriate to assume, that the time saved by the employees providing services to job seekers is reflected not by the value of working time, but the time value of employer representatives. The time value calculations are almost the same as the ones indicated in the chapter for the transport sector, except an adjustment factor is not applicable for the social security sector, reflecting the fact, that persons spending the most on transport also usually earn the most. Therefore the **value of working time** applicable to the social security sector, **when calculating according to prices of2013, is equal to 19.30 LTL/h, non-working time** – **7.72 LTL/h.**

Application instructions

In order to calculate the benefit of job search time economy, reflecting **increased public welfare due to faster employment of job seekers**, data on the number of moths of additional employment conditioned by faster employment of job seekers is needed. The implementer of a project should determine the number of additional months of employment of job seekers for every year of the CBA, having regard to the nature of investments, historical duration of employed persons staying in new jobs and other relevant aspects.

After determining the number of additional months of employment of job seekers for a specific year of the CBA, this number is multiplied by the additional gross monthly income received by one employed person (including the social taxes paid by the employer) expressed by shadow price. This way the total annual value of additional income (product created) due to faster employment is found.

[49] By applying a conversion factor, calculated as an average of the non-qualified labour conversion factor (0.888) and qualified work conversion factor (0.973).

A simplified calculation example is presented below.

Insert 3. Calculation example of job search time economy, reflecting increased public welfare due to faster employment of job seekers

Let's say a project for improving the infrastructure needed for faster service of clients of the territorial labour market is analysed. In view of performance of the infrastructure and customer behaviour characteristics the implementer of the project plans that improved infrastructure will help employ 10% more people annually.

Having regard to historical documents, current economic situation and forecasts published, the implementer of the project forecasts, that 2200 people will be employed after implementing the project, 200 of which will be employed due to improved infrastructure.

Let's say historical data shows that people employed in new jobs on average stay there for 6 months, after which they will come back to the labour market and will search for a job for 6 months. This means, that annually the number of additional months of employment is equal to: 200 persons * 6 months = 1,200 months.

Historical data also shows that persons employed faster will receive minimum salaries.

The total annual income of these persons employed is equal to: 1,200 months * 1,165 LTL = 1,398,000 LTL.

Source: compiled by "BGI Consulting" and "CSIL Milano"

In order to calculate the benefit of the last job search time economy component – **time saved by the job seekers and employer representatives**, data on changes in service time and the number of service procedures performed annually is needed.

The annual time economy benefit for job seekers is found by multiplying the non-working time value estimate by the change time needed for performing one service procedure and the time of such service procedures annually.

The annual time economy benefit for employer representatives is found by multiplying the working time value estimate by the change time needed for performing one service procedure and the time of such service procedures annually.

Comparison to other countries. The income received by the residents determine the value of avoided losses of created product due to faster employment, therefore the values of created products lost in the countries analysed (France, Germany, Italy, Spain and the United Kingdom) are much higher than the calculated value applicable for Lithuania.

Unit time value comparison with foreign countries is presented in the chapter for the transport sector.

Estimate update instructions

The value of avoided losses of created product applicable for an employed person receiving a minimum salary is recommended to be recalculated annually by using the algorithm indicated above.

The time value estimate update instructions are similar to the time value estimate instructions indicated in the chapter for the transport sector.

2. Increased availability of care services

Increased availability of care services is a typical impact of investments in the social security sector reflecting increased income (when the person who takes care of the person requiring care comes back to the labour market) or avoided care costs (when other people were hired to perform the care).

Calculation methodology and calculated estimate value

The benefit of increased availability of care services is advised to be calculated by using the avoided costs method. Avoided costs of similar, but more expensive services represent public willingness to pay for the services analysed. The willingness to pay and avoided costs concepts are described in Annex 2 of the Sector.

There is reason to believe, that the prices of services provided in the market are equal to minimum monthly gross salary (including the "Sodra" taxes paid the employer). I.e. the value of the avoided costs estimate is equal to **1,312 LTL per month.**

This estimate may also be applied in cases when care services were not purchased, because the person taking care is only able to earn minimum or close to minimum salary, therefore he/she took care of the family member/relative himself/herself. I.e. the proposed estimate represents both, avoided costs when there would not be need to hire a person to perform care and the costs avoided the person providing care and not participating in the labour market, which reflect the costs borne by the public due to loss of products created.

Application instructions

In order to calculate the benefit of increased availability of care services, data on the number of persons benefiting is needed. This number should be assessed by the implementer of the project having regard to the nature of the investments, regional specifics of the target group and other available information. The proposed estimate value is multiplied by the number of persons benefiting and by 12 months, this way the annual value of the benefit is found.

A simplified calculation example is presented below.

Insert 4. A calculation example of the benefit of increased availability of care services

Let's say a project for constructing a day care centre is analysed. Time in such centres could be spent by:

- Children: it is planned that 15 children will go to the centre, although from 10 families (this means that 10 persons providing care are needed);
- Elderly people: it is planned that 10 persons will spend their time in the centre;
- Disabled people: it is planned that 5 persons will spend their time in the centre;

Let's say the analysis also provides that some persons, who will be spending their time in the new centre, were taken care of by persons in exchange for compensation, and the rest – by family members and relatives. However, the proposed methodology says that in both cases, the benefit unit estimate is the same.

This means that 25 persons (10 persons, who take care of 15 children, 10 persons, who take care of 10 elderly people and 5 persons, who take care of 5 disabled people) will benefit from this.

The annual benefit value is: 25 * 1,312 LTL * 12 months = 393,600 LTL.

Source: compiled by "BGI Consulting" and "CSIL Milano"

Estimate update instructions

The estimate value is recommended to be updated annually.

Since it is not exactly known how the amounts in question will change in the future, the estimate value applicable for future years in the CBA time horizon is recommended to be increased according to the actual GDP per capita, calculated by the IMF[50].

3. Benefit provided by improved health of employed persons

The indirect impact of social security sector programs is also analysed in methodological literature, which occurs as improved health of an employed person. Employment gives the opportunity to have experiences important for health, such as structured use of time, activity, social contacts, collective aims and status[51].

Calculation methodology and calculated estimate value

Methodological literature recommends assessing this benefit as health care costs saved. For example, the average annual costs of national health care system calculated in the United Kingdom for one unemployed person is equal to 1,540 pounds[52]. A conservative assessment is proposed, that loss of employment

[50] Source: http://www.imf.org/external/ns/cs.aspx?id=28.

[51] The Department for Work and Pensions (2010), "Social Cost-Benefit Analysis framework. Methodologies for estimating and incorporating the wider social and economic impacts of work in Cost-Benefit Analysis of employment programmes", Working Paper No. 86.

[52] The Department for Work and Pensions (2010), "Social Cost-Benefit Analysis framework. Methodologies for estimating and incorporating the wider social and economic impacts of work in Cost-Benefit Analysis of employment programmes", Working Paper No. 86.

increases the health care costs of a person by 50%. This means, that after the person becomes employed, his/her health care costs decreases by 50%. / 1.5 = 33%.

In the case of Lithuania health care costs are published by the Statistics Department of the Republic of Lithuania. In particular, current health care costs are published in table "M3140801: Health Care Costs. Features: Health Care Functions, Year" in million LTL. Because the data are not published neither by age groups, nor by employment status, the average health care cost per capita amount is considered as a reference[53]. Although, on the basis of the arguments mentioned earlier, it would suggest that health care costs borne by an unemployed person are higher than the ones by an employed person, but otherwise, the health care costs of an unemployed person will be lower than the ones of an ill person, thus the amount of current health care costs per capita can be considered an appropriate estimate of health care costs borne by an unemployed person. In 2011 this value was 2,316 LTL. After recalculating to prices of 2013[54] and applying the costs reduction factor after employment (33%), the estimate of benefit provided by improved health of employed persons is **equal to 871 LTL annually for one employed person**.

Comparison to other countries. In the United Kingdom, the estimate applicable for Lithuania is based on the methodology which, the calculated value of the estimate is 508 pound sterling at prices of 2008, i.e. the national health care costs borne by the person are reduced by this amount after he/she becomes employed. The value applicable for Lithuania at prices of 2008 is approx. three times lower than the value of the estimate of the United Kingdom. Such difference can be explained by the gap between GDP per capita.

Application instructions

In order to calculate the benefit provided by improved health of employed persons, it is necessary to determine additional years of work, which can result from investments in the labour market infrastructure necessary for customer service, as well as investments in to infrastructure needed for care of children, elderly or disabled people, which could allow the persons providing care to get back into the labour market. The implementer of a project should determine the number of such additional years of employment for every year of the CBA, having regard to the nature of the investments, historical duration of employed persons staying in new jobs and other relevant aspects.

After determining the number of additional years of employment for a specific year of the CBA, this number is multiplied by the estimate value, thus finding the total annual benefit provided by improved health of employed persons.

A calculation example is presented below.

[53] The average annual number of residents is presented in table "M3010201: Number of Residents at the Beginning of the Year and the Average Annual Population. Features: Place of Residence, Sex" published by the Statistics Department of the Republic of Lithuania.

[54] According to the nominal GDP increase per capita published by the International Monetary Fund (http://www.imf.org/external/ns/cs.aspx?id=28).

Insert 5. Calculation example of the benefit provided by improved health of employed persons

Let's say a project for improving the infrastructure needed for faster service of clients of a territorial labour market is analysed. In view of performance of the infrastructure and customer behaviour characteristics the implementer of the project plans that the improved infrastructure will help employ 10% more people annually.

Having regard to historical documents, current economic situation and forecasts published, the implementer of the project forecasts, that 2200 people will be employed after implementing the project, 200 of which will be employed due to improved infrastructure.

Let's say historical data shows that persons employed in new jobs on average stay there for 6 months, after which they will come back to the labour market and will search for a job for 6 months. This means, that annually the number of additional years of employment is equal to: 200 persons * (6 months / 12 months) = 100 years of employment.

Therefore the annual benefit provided by improved health of employed persons is equal to: 100 * 871 = 87,100 LTL.

Source: compiled by "BGI Consulting" and "CSIL Milano"

Estimate update instructions

The values of an estimate are recommended to be updated annually. The estimate value applicable for the first year in the CBA time horizon is calculated by using the algorithm indicated above. The applicable estimate values of the CBA for future years are increased by taking the actual GDP increase per capita into account (according to forecasts of the International Monetary Fund[55]).

4. Increased possibility of socially vulnerable persons to get housing

Increased possibility of socially vulnerable persons to get housing is a typical benefit provided by investment in development of social housing. Such benefit is distinguished by both, studies performed abroad and an empirical cost benefit analysis performed in Lithuania[56].

Calculation methodology and calculated estimate value

Various methods can be applied in order to assess the benefit of increased possibility of socially vulnerable persons to get housing. One of the methods is willingness to pay for the social housing provided, calculated by stated preferences, although two major barriers would limit the application of this method. First, the willingness to pay of socially vulnerable persons would be inadequately low, due to the fact that they are

[55] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The IMF forecast does not cover the whole period of the economic analysis, thus considering arising uncertainties the annual increase rate for the remainder of the period is calculated according to the average of the annual GDP increase per capita forecast for the last five years.

[56] For example, A Feasibility Study of Šiauliai City Social Housing Construction and Operation, 2011 m.; a feasibility study by means of public and private sector partnership of project "Social Housing Development in Marijampolė Municipality", 2011.

unable to rent a similar housing in the private market. Second, special studies are needed for the application of this method, and they have not been performed in Lithuania.

Foreign literature also offers examples[57], the benefit of increase possibility of socially vulnerable persons to get housing is calculated by quality of life or increased satisfaction with life due to moving from a low quality housing rented in the private market to a provided social housing of better quality. The method is based on the analysis of various factors effect on the wellbeing of a person. A comprehensive, long-term database is needed for this purpose. For example, since 1991 in September-December an annual housing panel survey is performed in the United Kingdom, during which more than 10,000 adults are surveyed (a representative nationwide sample). This survey covers personal wellbeing factors, such as lack of space, noise caused by neighbours, noise from the street, poor lighting, vandalism, local environment (pollution), etc. According to the data of the survey it was determined, that with other factors being the same, life in poor quality housing, rented from local authorities would mean the same level of satisfaction in comparison with living in good quality housing, if a compensation of 973 pounds sterling for one person would be paid (with an average of two persons living in one household)[58]. Although such surveys are not performed in Lithuania, thus similar calculations are impossible.

Another method for calculating the benefit of increased possibility of socially vulnerable persons to get housing is the avoided costs method. I.e. the benefit is calculated **as a difference between the market rent price for housing similar to the social housing in question and the actual rent price for social housing**.

The market price of certain housing depends on a particular city, location, environment, the characteristics of the housing itself and other factors, so it is not possible to propose general values for this estimate. In order to determine the market price of social housing created by a certain project, it is recommended to consult real estate experts; it is also possible to rely on:

- The comparative apartment value map of the State Enterprise Centre of Registers[59];
- Order No. v-12 of the Director of State Enterprise Centre of Registers on certified average market values of real estate in Lithuania 01/02/2011, dated January 14, 2011;
- Publicly available real estate overviews[60].

When housing market value is available instead of rented housing market price, this value must be recalculated to monthly rent values. It is advised to consult real estate experts for the purposes of such calculations. Test calculations show, that usually the annual rent is equal to 1/22–1/12 of the market value of the housing (the upper limit is more common to Vilnius and other major cities with higher demand for housing).

A calculation example is presented below.

[57] For example, Fujiwara, D. (2013) "The social impact of housing providers", London: Housing Associations' Charitable Trust.

[58] Fujiwara, D. (2013) "The social impact of housing providers", London: Housing Associations' Charitable Trust.

[59] http://www.registrucentras.lt/bylos/dokumentai/st_butu.pdf; or http://www.registrucentras.lt/ntr/masvert13/verciu_zmlp.php.

[60] For example, http://www.ober-haus.lt/naujienos/nekilnojamojo-turto-rinkos-tyrimai, or http://www.ober-haus.lt/files/lt/files/apzvalgos/NT%20kainos%202013%20lapkritis.pdf.

Insert 6. Calculation example of increased possibilities of socially vulnerable persons to get housing

Let's say social housing in Vilnius city residential area will be created by implementing a project. A total of 15 apartments will be offered (all with two rooms).

Let's say it is planned that tenants will pay a monthly rent of 300 LTL for one apartment. The values presented in real estate overviews of November, 2013 show, that the monthly rent of two-room apartments in Vilnius city residential areas ranges from 650 LTL to 1,350 Lt[61]. The average rent price is 1,000 LTL.

Let's say consultations with a real estate expert show that this 1000 LTL monthly rent corresponds to the value of the social housing created.

In this case the annual benefit of the project is equal to: 15 * 12 * (1,000 – 300) = 126,000 LTL.

Source: compiled by "BGI Consulting" and "CSIL Milano"

[61] For example, http://www.ober-haus.lt/files/lt/files/apzvalgos/NT%20kainos%202013%20lapkritis.pdf.

1.2.4. The Socio-Economic Impact Table of the Social Security Sector

In summary, the socio-economic impact estimates are presented in the technical assignment set out in the form of a table (table **Error! Reference source not found.**). According to the requirements of the technical assignment, the indicator table must be associated with the conversion factors set by the service provider in order to ensure that there is no double-counting of benefit and damage. Although none of the estimates determined are associated with the set conversion factors applicable to the costs; therefore there is not risk of double-counting benefits and damages.

Table 28. The socio-economic impact estimates established for the social security sector

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload *(table of strong, reliable and significant ratings (at least three))*	Quantitative expression, Lt
Social Security	N/a	N/a	1. Job / Employee search time economy	The following estimates are used for determining job search time economy: - **1,165 LTL / month** avoided loss of the created product (the value is applied to persons receiving minimum salary[62]); - **19.30 LTL / h** value of working time, applicable to the time saved by employer representatives; - **7.72 LTL / h** value of working time, applicable to the time saved by job seekers;
Social Security	N/a	N/a	2. Increased availability of care services	The value of the avoided care costs estimate is equal to **1,312 LTL per month.**
Social Security	N/a	N/a	3. Benefit provided by improved health of employed persons	**871 LTL** annually for one employed person.
Social Security	N/a	N/a	4. Increased possibilities of socially vulnerable persons to get housing	The benefit is calculated as: - The difference between the market rent price for housing similar to the social housing in question and the actual rent price for social housing.

[62] If due to faster service for job seekers and employers, the unemployed persons employed faster will get higher average salaries than minimum salaries, then the applicable, more suitable, estimate value is calculated in accordance with the instructions presented in the benefit component calculation methodology.

Notes:* The indicator table must be associated with the conversion factors set by the service provider in order to ensure that there is no double-counting of benefit and damage.

1.2.5. Annexes (Social Security Sector)

Annex 1. The Benefit (Damage) Components Applicable to Different Project Types

Project type	Applicable benefit (damage) components
1. Investments in necessary infrastructure for customer service	1. Job search time economy 3. Benefit provided by improved health of employed persons
2. Investments in development of a stationary social service infrastructure	2. Increased availability of care services 3. Benefit provided by improved health of employed persons
3. Investments in development of a non-stationary social service infrastructure	2. Increased availability of care services 3. Benefit provided by improved health of employed persons
4. Development of social housing	4. Increased possibilities of socially vulnerable persons to get housing

Annex 2. Willingness to Pay

The willingness to pay concept is often associated with assessment of project results. According to this concept, the total value of the benefit and damage created by a project is assessed by adding maximum values, which people are willing to pay in order to get desired project results. Result categories may cover both, goods and services actually sold in the market and the ones not sold (including external impact). In the first case, even if users pay a set rate, it may be distorted and not reflect neither the total costs of production nor possible additional benefit or damage, created by producing such goods or providing such services. Public or publicly provided goods, such as health care or public transport, for which the users pay subsidized rates, are typical examples. In such cases the willingness to pay is a better estimate of the social value of such goods than a monitored rate.

The importance of the willingness to pay method becomes more obvious if a project creates an external impact, for which monetary compensations are not paid. The general rule of external impact states, that such external impact must be estimated in a monetary form and added to the economic analysis of the project. This allows assessing the increase in overall wellbeing by taking the wellbeing changes of everyone receiving benefit or damage due to the project.

The willingness to pay method is also applied in assessing the resources used in the production process of the project, when using such resources leads to changes of the net demand for such resources by other users. The economic value of such resources will not be assessed as long run marginal costs incurred in production of this resource, because there is no impact on marginal production. In this case the economic value of a resource is represented by the price, for which this resource may be purchased for from another user. Although in real-world situations, in conditions of market distortion, the prices do not fully represent the actual economic value of goods. Therefore, the best way to assess the economic value of such goods is to base calculation on the maximum price, which a user is willing to pay for such goods. Alternatively, calculations may be based on the opposite perspective, i.e. the minimum price, for which a seller would be willing to sell the goods (the willingness to accept method)[63].

Corresponding methods must be applied in order to empirically assess willingness to pay. A broader definition of such methods is presented below:

The stated preferences method

When benefit and damage cannot be assessed simply by monitoring market prices, due to market distortion or in case the market does not exist, the value of such benefit or damage can be found by directly asking people what maximum amount they would be willing to pay for the change of the number of goods or a hypothetical increase in the quality of

[63] According to economic theory the willingness to pay and the willingness to accept concepts are equivalent (the first one is usually used for assessing benefit, the second – for assessing damage / costs). However, it has been empirically demonstrated that limited rationality of individual determine higher willingness to accept estimates in comparison with similar willingness to pay estimates. This is because people are prone to demand higher monetary compensation for their goods in comparison with the indicated price, which they are willing to pay for the similar goods, which they do not have.

goods. The most common method for determining personal preferences is the contingent valuation method, when a sample of the population is surveyed and conclusions about the whole population are drawn based on the results.

The revealed preferences method

Contingent valuation may be very expensive and time-consuming. Therefore, as an alternative, personal preferences towards certain goods may be assess by observing behaviour and purchase transactions associated with other goods or markets. This approach is suitable for valuation of non-market goods. Different methods may be applied in order to reveal preferences:

- The travel cost method: the value of goods is determined by total travel costs incurred in order to use these goods (fuel, plane and train tickets, accommodation costs, costs of time spent traveling, etc.).
- The hedonic price method: the value of goods is determined by monitoring the value of other goods, which depends on the value of the goods in question (for example, the value of urban air quality is determined by monitoring price differences in the real estate market, based on the assumption that the home prices are influenced by air quality).
- Avoidance of defensive method: usually used for assessing negative external impact. Economic value is assessed according to costs, incurred by protecting against harm or mitigating actual or potential adverse results.
- The cost of disease method: similar to the defensive cost method. This method is based on costs, incurred by neutralizing adverse effects on health, incl. medical care costs, as well as – decreased income streams caused by a disease, injury or death.
- The avoided costs method: this method is considered the most appropriate when contingent valuation for determining individual preferences in case of a specific project cannot be performed due to time and resource constraints Avoided costs of similar, but more expensive services represent public willingness to pay for the services analysed. This method may be used for assessing various goods, for example, when assessing the willingness to pay of people planned to be connected to the central water supply system for such connection, willingness to pay of people for the in-patient or out-patient care of their family or relatives, or the willingness to pay of parents for the preschool education services of their children, etc. The avoided costs reflect the costs for alternative services, which are purchased or would be purchased if the project would not be implemented. For example, in the case of state preschool education services, the costs avoided would be reflected by costs for a nanny or a private kindergarten (or the average, if these services are equally popular).

The benefit transfer approach

The essence of the benefit transfer approach – exploitation and use for assessment of the same goods in a different context or other populations of results of current surveys or results revealed by preference exercises, were aim towards assessing the willingness to pay for certain goods. Values taken from other studies have to be adjusted taking the technical, socio-economic, geographic properties of the project assessed as well as the ones associated with the perspective of time. This would ensure that results would still be valid in a context, where initial values were not applied. Adjustment of initial values is most commonly based on the gross domestic product or similar indicators.

1.3. Education and science

1.3.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.3.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The choice of the socio-economic benefit (damage) components was based on the approved list of common education and science sector's project types (Table 29).

Five of the approved types are related to investments for the purpose of increase the capacity of the educational infrastructure and the availability of services or to improve learning environment and education infrastructure quality. These projects reflect different levels of educational system in Lithuania (from pre-primary level to the higher education) and include both formal and non-formal education services. One type of the projects is exclusively associated with research and development infrastructure.

Table 2. Common education and science sector's project types.

Project type	Project examples
1. Investment in pre-school infrastructure and environmental modernization	1.1. Kindergarten modernization by renewing facilities and equipment 1.2. Investments in infrastructure necessary for integration of children with special needs in pre-school establishments
2. Investment in general education infrastructure and environmental modernization	2.1. Renovation of equipment and furniture in general education schools 2.2. Renovation of general education institutions' premises 2.3. Modernization of libraries in general education schools 2.4. Investments in infrastructure necessary for integration of children with special needs in general education institutions
3. Investment in vocational education infrastructure and environmental modernization	3.1. Development of vocational training centre's infrastructure 3.2. Renovation of vocational training institutions' premises and equipment 3.3. Investments in infrastructure necessary for integration of persons with special needs in vocational training institutions
4. Investment in studies infrastructure and environmental modernization	4.1. Renovation of studies' infrastructure and equipment 4.2. Renovation of premises of studies' institutions 4.3. Investments in infrastructure necessary for integration of persons with special needs in learning institutions

Project type	Project examples
5. Investment in RDI infrastructure and environmental modernization	5.1. Renovation of laboratory and computer equipment, as well as software necessary for RDI activities
6. Investment in non-formal education infrastructure and environmental modernization	6.1. Modernization of children non-formal education environment 6.2. Creation of education support infrastructure

Source: developed according to the information provided by BGI Consulting and CSIL Milano, SFMIS, strategic planning documents and Ministry of Education of the Republic of Lithuania.

Long-term social and economic objective of educational services improvement (1-4 and 6 types of projects) is consistent with the publically available human capital increase, which, in turn, affects the economic growth. Specific benefit related to these types of projects is the following:

- Increased availability of pre-school infrastructure and services
- Improved quality of general (primary and secondary) education infrastructure and services
- Increased availability of non-formal education infrastructure and services
- Increased human capital value.

Benefits of the projects, which belong to the 5th type (investment in RDI infrastructure and environmental modernization), are related to:

- Increased human capital value
- Creation of knowledge, which is reflected by the increase in scientific publications and cases of their citing
- Commercialization of innovative performance
- Technological external effects, which are manifested in the form of spin-off companies.

Educational and scientific investment projects do not have a significant impact on the external environment. EC Guidelines of 2008 indicate that the only possible economic damage could be increased congestion but, for example, this damage was not identified in empirical CBA of Lithuanian projects [64]. If the promoter indicates noise or pollution impact resulting from constructions or during the operational phases, then the incurred economic costs must be assessed in accordance with the methodology for the transport sector.

Below a detailed selection of benefits (damages) components is provided (Table 3).

Table 4 . Arguments of selection of benefits (damages) components

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Willingness to	Direct	Education and care in early childhood is considered to have a great

[64] For example: The establishment of national open access RDI centre within Kaunas University of Technology; Creation of National Physical and Technological Sciences Center.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
pay for the increased availability of pre-school education services	impact	importance to creating conditions for all children and opportunities to realize their potential[65]. This objective is long-term strategies intended to improve educational systems in all EU member states and complies with the aims of smart, sustainable and inclusive growth indicated in the strategy Europe 2020. Education and care systems for lower than school age children are different in individual EU countries. In order to increase availability of early children education, it is intended to increase the number of children (from 4 years old to the beginning of the compulsory education) attending pre-school establishments up to 85 %; in the year 2020[66] it is foreseen as one of the criteria for evaluation of the national progress program for the year 2014-2020. The economic value of the pre-school services increase (both for children, younger than 4 years old and older) can be determined by assessing the willingness of the parents to pay for such services.
2. Willingness to pay for the improved educational infrastructure and quality of service	Direct impact	The ultimate goal of investments intended for the improvement of the environment of the general education, by renewing the equipment, furniture or premises, is to improve children learning results and increase the number of students with secondary education. These objectives are indicated in Lithuanian strategic documents and comply with European strategic aims to reduce the number of school leaves[67], to provide a stimulating work environment and to make schools dynamic institutions, which promote creativity[68]. Willingness of the parents to pay for children to attend a modern and renewed school reflects the benefit of the education infrastructure and environment improvement.

[65] European Commission Communication “Early Childhood Education and Care: Providing all out children with the best start for the world of tomorrow”, COM(2011) 66 final, Brussels, 17.02.2011.

[66] At the EU level, the objective is to achieve the part of 95 % (Conclusions of the Council from May 12, 2009 on the European cooperation strategic program in the field of education and training, ET 2020, 2009/C 119/02).

[67] Communication from the Commission to the European Parliament, the Council, European Economic and Social Committee and Committee of the Regions „ESL reduction – one of the most important objectives of the Europe 2020“, COM (2011) 18 final.

[68] Conclusion of the Council and the representatives of the Governments of the Member States - to prepare young people for the 21st age: agenda of European cooperation on schools (2008/C 319/08).

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
3. Willingness to pay for the increased availability of non-formal education services	Direct impact	It is recognized [69], that people acquire knowledge, skills and competences not only at school, university or other educational institution, but also outside of the frames of the formal education system. Non-formal education mainly involves voluntary courses of transmission of working knowledge or literacy, organization of cultural activities or sports, other services intended to promote personal development, employability and participation of citizens in public life. In traditional CBA[70] social and economic value of such activities is reflected by the participants‘willingness to pay for non-formal education.
4. Increase in wages achieved due to the improved skills	Direct impact	Theoretical and empirical evidence in the field of educational economics prove that education and vocational training contributes to the increase in the publically available human capital, which makes endogenous effect to the economic growth. In order to determine human capital formation threshold effects, studies are usually based on the increase in the revenue gained by educated persons, as it reflects new skills. This method of assessment is proposed in EC Guidelines of 2008. Both at national and European level human capital development is considered as very important to maintain economic growth and competitivenes[71]. Maintaining of the number of persons with higher and equal education, as well as increase in the number of doctoral graduates is determined as criteria for assessment the national progress program of the year 2014-2020. The role of the higher education in society is also emphasized at EU level and enshrined in the strategy „Europe 2020“. Better vocational training is also contributing to the improvement of workers’ skills. On the 7th of December, 2010 European Ministers reliable for the vocational training, European social partners and the

[69] Resolution of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, on the recognition of the value of non-formal and informal learning within the European youth field [Official Journal C 168, 20.7.2006].

[70] For example, such a method was proposed in the EC Guidelines of 2008.

[71] The National Progress Program of the year 2014-2020 (challenges to improve the quality of education, to strenghten the RDI infrastructure, as well as the human capital and others); EU strategy for smart, sustainable and inclusive growth „Europe 2020“.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		European Commission approved the Bruges Communique on enhanced European cooperation in the area of vocational training for the year 2011-2020.[72] Objectives of this communication defined a new impetus of the Member States to increase the quality and attractiveness of vocational training.
5. The value of knowledge creation (benefit of the research publications' preparation)	Direct impact	Investments in research, development and innovations are in the middle of EU political agenda, as the main guarantee of sustainable long-term economic development, welfare and quality of life. Over the last decade, EU has pursued RDI innovation capacity development, thus focusing on the final destination – to make EU by knowledge-based economy and to regain global leadership in the area of high-level scientific and technological progress. The strategy "Europe 2020", and especially the flagship initiative "Innovation Union" puts RDI and innovation to the top of the EU's smart, sustainable and inclusive growth, as well as sets the goal to increase public and private investment in RDI at EU level up to 3 % of GDP in the year 2020.
6. The value of the knowledge creation (benefit of the research publications' citation)		The main direct benefit of the research infrastructure is creation of new knowledge. Knowledge is an intangible good, which has its value regardless of its actual use and commercial application. Method for determination of the value of intangible goods, such as knowledge, is based on determination of the knowledge physical products' economic value, i. e. determination of economic value of scientific publications published in scientific periodicals and research monographs, as well as citing cases of publications by Lithuanian researchers. The value of publications is also recognized in Lithuanian strategic documents: increase in scientific publications' citing is determined as one of the assessment criteria of the national progress program for the year 2014-2020.
7. Innovative performance commercialization value	Direct impact	RDI infrastructure, especially related to the practical adaptation of RDI results, may generate innovation. As highlighted in the strategy „Europe 2020", innovative products introduced in the market generate wealth improvement and socio-economic value. Innovation may be useful to health, save energy, increase the competitiveness of enterprises, and improve transport and so on. The benefit of innovations developed by RDI infrastructure, occurs in

[72] "The Bruges Communiqué on enhanced European Cooperation in Vocational Education and Training for the period 2011-2022", 7 December 2010.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		the following two forms: • By selling services or products (such as prototypes), according to the customer's orders and specifications, by concluding targeted research contracts; • By commercialization of patents acquired due to the infrastructure and providing licences'suggestions. Commercialization of innovative performance provides both financial income (in terms of financial analysis) and impact on the economy as the whole, the value of which must be properly evaluated in the economic analysis of investment products.
8. Spin-off companies economic value	External impact	RDI infrastructure can be linked with creation of spin-off companies' [73] to commercialize the results of research. The project analysis shall assess the positive impact of such companies' creation to social and economic well-being. Spin-off companies of one of the ways in which the knowledge of RDI and universities can reach the market. Therefore, spin-off companies directly contributes to the creation of business opportunities and innovation in order to enhance the socio-economic competitiveness (which contributes to the terms of the strategy „Europe 2020"). In addition, attention to the spin-off companies is allocated in the national progress program for the year 2014-2020. The benefit of this innovative performance is reflected in retained profits earned by the spin-off company during its life cycle.

Source: prepared by the BGI Consulting and the CSIL Milano.

Attribution of benefits (compensation) components to specific types of projects is in the sector in Annex 1.

1.3.3. Calculation Methodology and Application Instructions

1. The willingness to pay for the increased availability of the preschool education services

The main benefit is related to the investment into the infrastructure of the preschool education, the availability of the public (state's) kindergartens is increased to the kids of the lower than required school age.

[73] Spin-off company is a company established to commercialize the results of innovation activities or RDI.

Calculation methodology and calculated estimate value

To determine the value of the increased availability of the preschool education services, the suggested method is based on the determination of the number of parents, who are willing to pay for the improvement of the public preschool education structure. For the calculation of this value the most suitable is the method of the avoided costs, expressing the willingness to pay for public services via the avoided costs, which would be experienced by using alternative, more expensive providers of the same services.

It is likely, that the investments into the preschool education infrastructure and the modernization of the surroundings will concentrate on the more populated areas (largest cities), in which the income is higher than average. That is why most likely alternative of the public preschool education services available for the parents is private preschool education services, which could be provided in two forms: form of a private kindergarten or the form of the babysitter, taking care of the kids at home (also the alternative of the late return to work is analyzed further).

This way, the avoided expenditure could be calculated as:

- The average market price of the babysitter hired to take care of the child: at the approximate average price of 6.9 LTL/h, monthly price would come to 1,241 LTL, by counting 9 hours per day and 20 days per month; the yearly price would come to 13,656 LTL;
- The average market price paid for child's education in the private kindergarten: at the average price of 833 LTL/month, the yearly price would come to 9,167 LTL.

The average yearly price of the private kindergarten and babysitter was calculated for the period of 11 months, assuming that during the time of the parental summer vacation the services of childcare are not needed[74]. The research technique on the basis of which the average market prices were set is presented in the 2 appendix of the sector.

The estimate's value of the willingness to pay is the same despite the age of the age of the preschooler, because the market price of the education/care services does not vary.

According to the availability of the information, the calculations of the estimates of the benefit's component were based on the prices observed in the city of Vilnius. Setting different estimates for the separate regions or cities would be inappropriate, because in that case the infrastructure identical from all other points of view would generate a different return, and that would be socially wrong. It is also necessary to take into the consideration the fact, that person with the lower income, values one litas more than the person with the higher income. For the purposes of the simplification and also according to the existing uncertainties, average observed prices, basing the calculations on the city of Vilnius, were converted into the values applied to the whole Lithuania[75] (table **Error! Reference source not found.**).

[74] Many private kindergartens also provide the possibilities, not to pay the fee when a child is not attending the kindergarten, during the time of the parental vacation.

[75] The average prices observed in the city of Vilnius were multiplied by the average gross monthly salary in the Republic of Lithuania in the years 2008-2012 and divided by the corresponding indicator of the Vilnius city (according to the data of the Department of Statistics of Lithuania table "M3060838: >>>Average gross and net monthly salary. Attributes: administrative territory").

Table 31. Avoided singular expenditure of the private care, LTL (prices of the year 2013)

The type of the child care service	Average market price per month, LTL	Average market price per year (11 months), LTL
Private kindergarten	833	9,167
Private babysitter at home	1,241	13,656

Source: prepared by the BGI Consulting and the CSIL Milano.

Another possible alternative, for the parents, to whom the services of the public preschool education services are not available, is the late return to work. Usually mothers more than fathers are more inclined to delay the return to the job market due to these purposes. The costs of the late return to the job market reflects the costs that fall to the society due to the loss of the created product. The costs of the late return to the job market are equated with the women's average yearly gross salary in Lithuania (including social employer's contributions), expressed in shadow price.

The women's average monthly gross salary is published in the table of the Department of statistics of Lithuania "M3060846: Average monthly salary. Features: sex, sector", the value of the year 2012 is equal to 1974 LTL. After the addition of the employer's social fees, making up additional 31.2 %, we get:

1,974 LTL * (1+0.312) = 2,590 LTL.

This value was recalculated into the value of the year 2013 according to the prognosis of the country's average salary provided by the finance ministry of the Republic of Lithuania[76], according to which country's average salary in the year 2013 should increase from 2123,8 LTL to 2229,6 LTL. Therefore the women's average monthly gross salary in Lithuania, including social contributions of the employer, in the year 2013 is equal to:

2,590 LTL * (2,226.2 LTL / 2,123.8 LTL) = 2,715 LTL;

After the application of the conversion coefficient[77] we get the women's shadow salary in Lithuania (table**Error! Reference source not found.**).

Table 32. Avoided local costs of the late return to the job market, LTL (prices of the year 2013)

	Shadow costs of women's work (per month)	Shadow costs of women's work (per year)
The women's average monthly gross salary, including social contributions of the employer (shadow price)	2,526	30,313

Source: prepared by the BGI Consulting and the CSIL Milano.

Comparison with other countries. The types of care means of the children of the lower than mandatory school age could vary between the countries due to the existing income level and cultural differences. The

[76] Source: http://www.finmin.lt/web/finmin/aktualus_duomenys/makroekonomika.

[77] Calculated as a simple average of the conversion coefficient applicable to the qualified work force (0.973) and the conversion coefficient applicable to the unqualified work force (0.888).

price of the child care is also very different. Private child care services in Lithuania are considered as relatively expensive (I.e. expensive, in comparison to income level)[78]. Relatively expensive private child care services are also characteristic to Cyprus, Greece, Spain, Hungary, Poland, Estonia and Slovakia. For example, according to the data of the year 2008, such services in Greece cost 300–600 euros (1,036–2,072 LTL) per month[79].

Application instructions

As shown, the willingness to pay for the increased availability of the preschool education services could be calculated by three different methods: as the avoided private kindergarten fee, avoided costs of the hiring of private babysitters or lost salary due to a late return to the job market. If there is no solid data how the receivers of the benefit would distribute according to the chosen alternatives, it is insistently recommended to treat, that every alternative is chosen by the one third of the benefit receivers. If the solid data about the expected distribution of the benefit receivers is available, the person who is conducting the analysis of the project, should refer to it when determining the proportions of the benefit receivers. For example, if the priority is given to the hiring of the babysitters that arrive to the home, the value of the willingness to pay is equal to 1,241 LTL per month or 13,656 LTL per year. If it is more likely that parents will choose the care and education of the child in the private kindergarten, the value of the willingness to pay is equal to 9,167 LTL per year. Investment project would generate the greatest benefit in that case, if it would allow for mothers not to delay the return to work: the value of the willingness to pay for the public investments in this case would be 30,313 LTL for each avoided year of the late return to work.

In order to evaluate the willingness to pay for the increased availability of the educational services further specified information is needed:

- The territory affected by the project / population, for example number of families (or mothers), that could potentially benefit from the increased availability of the preschool education services;
- The type of the children care alternative, which would be chosen in the absence of the project. If more than one alternative is common, must be evaluated what part of mothers choose which alternative. I. e. must be evaluated which part of mothers choose a private kindergarten as a priority, which - hiring of the private babysitters and which - the delay of the return to work;
- The yearly value of the willingness to pay for the project, which is calculated as the avoided costs, which would be incurred if the project would not be implemented (i.e. the costs of: the private babysitters hiring, the private kindergartens or the lost salary.). If more than one alternative of child care exists and is applied, the willingness to pay must be calculated as a weighted average of the avoided costs related to the each alternative, using the part of the benefit receivers, who would choose a concrete alternative if the project would not be implemented, as weights.

[78] European Commission (2009) "The provision of childcare services. A comparative review of 30 European countries", prepared by Janneke Plantenga and Chantal Remery, DG for Employment, Social Affairs and Equal opportunities, G1 Unit, European Commission, Brussels (http://ec.europa.eu/social/main.jsp?langId=it&catId=89&newsId=545&furtherNews=yes).

[79] European Commission (2009) "The provision of childcare services. A comparative review of 30 European countries", prepared by Janneke Plantenga and Chantal Remery, DG for Employment, Social Affairs and Equal opportunities, G1 Unit, European Commission, Brussels (http://ec.europa.eu/social/main.jsp?langId=it&catId=89&newsId=545&furtherNews=yes).

The payments paid to the parents by the state during the first year or first two years of the child are not considered an economic benefit. Such payouts are treated as executable payments (eng. *transfer*), which are a benefit for a mother (father) who cares for the child, but the costs for the state. Although if implemented project creates the possibilities to return to work earlier (for example, not after two, but after one year), the losses of the created product would be avoided, that can be easily evaluated based on the shadow compensation for work, which did not get the mother (father) who is caring for the child.

Estimate update instructions

The values of the estimates of the willingness to pay for the avoided private child care, reflecting prices of the year 2013, could change during the year. It is recommended to renew the value of the benefit component every year. The value applied to the first year of the CBA, is calculated by increasing the value of the year 2013 proportionally to the nominal growth of the GDP per capita (according to the statistics published by the International Monetary Fund[80]). The values applied to the first year of the CBA period are calculated by increasing the value of the first CBA year proportionally to the real growth of the GDP per capita (according to the statistics published by the International Monetary Fund[81]).

When performing the survey of the educational services market, it is recommended to update the value, applied to the first years of the CBA period every five years (when questioning the respective level's subjects, which provide services, when addressing the experts of this sphere, etc.).

It is also recommended to update the value of the avoided costs of the late return to the job market every year. The value of the benefit component's estimate applied to the first year of the CBA is calculated accordingly to the above presented instructions. The values applied to the future years of the CBA, are calculated by increasing the value of the first year of the CBA proportionally to the real growth of the GDP per capita (according to the prognosis of the International Monetary Fund[82]).

2. The willingness to pay for the improved quality of the educational infrastructure and services

With the investments into the renewal of the equipment, furniture or premises and the modernization of the libraries of these establishments the improvement of the quality of the educational infrastructure and services is sought, while having the objective to improve the achievements of the students studying. Such investments are common for the state's schools as well as for the private ones too.

Calculation methodology and calculated estimate value

The benefit provided by the public investments, aimed at the modernization of the infrastructure of the primary education, could be expressed in the willingness of the benefit receivers to pay for the improved quality of services and the infrastructure of the educational institutions.

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[80] Source: http://www.imf.org/external/ns/cs.aspx?id=28.

[81] The same. IMF prognosis does not include the whole period of economic analysis, therefore, given the occurring uncertainties, the yearly growth pace for the rest of the period is calculated as an average of the growth pace of the yearly GDP per capita during the last five years of the prognosis.

[82] The same.

One of the methods to calculate the value of the willingness to pay is the evaluation of the contingent. When performing the evaluation of the contingent, parents are requested to specify the maximal amount of money, which they would be willing to pay for the unrenovated school and for the renovated modern school. The difference between these two values would reflect the value of the benefit provided by the improvement of the education infrastructure and the service quality.

The willingness to pay for the modernization of school in this technique is evaluated by using the yearly fee sum observed in the market, that parents would pay for a private school, which provides the same services, which will provide the analyzed school after the performed renewal due to the investments for the project fulfilment. According to the availability of the information, the calculations of the estimates of the benefit's component were based on the prices observed in the city of Vilnius. Based on the performed survey of the Vilnius private schools, fee for the academic year in the private school could be from 5,400 LTL (as for primary as well as for the secondary education) up to the maximum sum of 9,405 LTL in the case of the primary education and the maximum sum of 11,646 LTL in the case secondary education.

As in the case of the preschool education, setting different estimates of the benefit component for the separate regions or cities would be inappropriate, because in that case the infrastructure identical from all other points of view would generate a different return, and that would be socially wrong. It is necessary to take into the consideration the fact, that a person with lower income, values one lit more than the person with the higher income. For the purposes of the simplification and also according to the existing uncertainties, average observed prices, basing the calculations on the city of Vilnius, were converted into the values applied to the whole Lithuania[83]:

- the estimate of the minimal fee for the academic year in the private school applied for the whole Lithuania is equal to 4,560 LTL (in case of the primary as well as in the case of the secondary education), and the estimate of the maximal fee – 7,943 LTL in the case of the primary education and 9,835 LTL in the case of the secondary education.

A person, who is performing the analysis of the project, could evaluate the willingness to pay for the improved quality of the private educational infrastructure as the difference between the maximal fee for a private school and the fee applied by the analyzed private school in the scenario without the fulfilment of the project.

In case of the education in the state institutions, for which fee from parents is not collected, it is suggested to treat private schools as a more expensive alternative and the fee paid by the parents for the private schools should be treated as the maximum sum of money, which the parents would be willing to pay for the improved infrastructure of the general education.

This point of view is based on two main premises: the first, private schools usually offer better educational services in comparison with state's schools, have more of the modern equipment and more comfortable premises; the second, state's schools when renewed achieve the same level of the educational infrastructure and service quality as private schools.

In reality the second premise not always applies: it is accepted that private schools could have certain additional advantages when compared to the renovated state school (for example, more choices of the

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[83] The average prices observed in the city of Vilnius were multiplied by the average gross monthly salary in the Republic of Lithuania in the years 2008-2012 and divided by the corresponding indicator of the Vilnius city (according to the data of the Department of Statistics of Lithuania table "M3060838: >>>Average gross and net monthly salary. Attributes: administrative territory").

extracurricular activity or a better studying environment). Because of this reason, in order not to overrate the economic benefit provided by the quality improvement of the state's educational infrastructure, it is suggested to estimate the willingness to pay for the quality improvement of the state's educational infrastructure based on the minimal fee for the private education. As mentioned, the smallest yearly fee for the private general education makes up 4,560 LTL for one student per year. This fee sum applies in the case of the primary education as well as in the case of the secondary education.

Table 33. The willingness to pay for the improvement of the primary education infrastructure and services, LTL for one student per academic year (prices of the year 2013)

	The willingness to pay
The infrastructure and services of the private institutions of the education	• Primary schools: the difference between 7,943 LTL and the fee, paid in the scenario without the fulfilment of the project • Secondary schools: the difference between 9,835 LTL and the fee, paid in the scenario without the fulfilment of the project
The infrastructure and services of the state's institutions of the education	4,560 LTL

Source: prepared by the BGI Consulting and CSIL Milano.

Comparison with other countries. The proposed methodology could be applied in any state of the EU, only the value of the willingness to pay and the fee paid to the institutions of the private education will differ, based on which the willingness to pay is estimated. No studies, that would provide the extensive comparison analysis of the market prices of the primary and secondary education in the EU states, are conducted. However, it could be stated, that the market price of the educational services depends on the quality of the education as well as on the level of the living standard.

Application instructions

The willingness to pay for the quality improvement of the educational infrastructure firstly should be multiplied by the number of students, which will profit from the investments benefit, and the obtained value must be included into the costs and benefit part of the analysis, beginning with the conclusion of the renovation and ending with the finish time of the analysis.

In the case of investments into the infrastructure of the institutions of the private education, the fee for a private school is paid as in the scenario in which the project is fulfilled as well as in the scenario without the fulfilment of the project, that is why when assessing the willingness to pay for the project not the maximum fee, paid by the parents to the private school for their child, should be used, but the difference between the maximum fee and the fee which would be really paid in the scenario without the fulfilment of the project, should be used.

Estimate update instructions

The values of the willingness to pay for the improvement of the quality of the services and infrastructure of the education could be updated when the evaluation of the contingent is done by the subjects, that perform the research of this sphere, and when the values of the willingness to pay, evaluated on the basis of the preferences expressed by the parents, are published.

If such research will not be performed, it is suggested to update the values of the estimates of the benefit component every year. The value applied to the first year of the CBA calculated by increasing the value of the year 2013 proportionally to the nominal growth of the GDP per capita (according to the statistics published by the International Monetary Fund[84]). The values applied to the future years of the CBA, are calculated by increasing the value of the first year of the CBA proportionally to the real growth of the GDP per capita (according to the prognosis of the International Monetary Fund[85]).

When performing the survey of the educational services market, it is recommended to update the value, applied to the first years of the CBA period every five years (when questioning the respective level's subjects, which provide services, when addressing the experts of this sphere, etc.).

3. The willingness to pay for the increased availability of the informal education services

The benefit of the investments into the informal education infrastructure is felt by various users of this infrastructure: adults (to whom, for example the establishment of multifunctional centers, that are dedicated to the exercising of the cultural, wellness promotion and similar activities, are relevant) and kids (to whom, for example the establishment of the extracurricular activity centers is relevant) as well.

Calculation methodology and calculated estimate value

The value of the increased availability of the informal education services could be determined based on the willingness of the benefit receivers to pay. The willingness to pay could be calculated by various methods, depending on the nature of the project's benefit receiver.

If the investment project is oriented at **the infrastructure dedicated to the needs of adults**, the willingness to pay is equated to the total cost of the travelling, which is needed to reach the services provided because of the infrastructure. Usually such costs are taken into the consideration when seeking to determine the value of the recreational places of interest and value of the services provided by them, however, it is also useful to consider them when calculating the value of the increased availability of the informal education services. The mentioned costs consist of: monetary travel expenses (bus ticket, car fuel and so), time, dedicated to reach the infrastructure and to participate in the activity organized by it, value and the price of the entrance into the center of informal education (if exists).

When evaluating the willingness to pay by the method of the paid travel costs, the estimates of the time value and the value of the vehicle maintenance costs (VMC) for one visitor are needed.

Time value for the passengers travelling on a non-job related matters, when calculating in the prices of the year 2013, is equal to 11.73 LTL/h (detailed, methodical provisions for the calculations are provided in the

[84] Source: http://www.imf.org/external/ns/cs.aspx?id=28.

[85] The same. IMF prognosis does not include the whole period of economic analysis, therefore, given the occurring uncertainties, the yearly growth pace for the rest of the period is calculated as an average of the growth pace of the yearly GDP per capita during the last five years of the prognosis.

chapter dedicated to the transportation sector). In the meantime VMC value applied to the cars in Lithuania, in the prices of the year 2013, is 0.83 LTL/km[86] (with fees).

If the investment project covers **infrastructure, which is dedicated to provide the extracurricular activities for children**, willingness to pay could be calculated as:

- The avoided costs of the alternative more expensive provision of the same service (for example, done by a private institution instead of state's). Due to the large variety of the informal education activities provided by the fulfilment of the project, it is impossible to provide the singular value of the willingness to pay. Because of that, prices, paid for the use of the same, but more expensive services, provided by the institution, could also very differ. Because of that, it is suggested to assess the willingness to pay on a case to case basis.
- Because of children's participation in the extracurricular activity, avoided costs of the child care services, for which parents have to pay, so that the children be taken care of after lessons while parents are at work. The market price for the private babysitter, equivalent to the value of the willingness to pay for the increased availability of the preschool infrastructure, is almost **6.9 LTL per hour**.

Comparison with other countries. The differences of the incurred monetary transportation expenses (fuel, bus ticket and so) to reach the informal education services between the countries are not big, however, other elements - the time value, market price of the informal education, the market price of the babysitter - very much depends on the economic capacity of the state, measured by the GDP per capita, I.e. differences between the states mostly are determined by the GDP per capita.

Application instructions

When assessing **the willingness to pay for a certain infrastructure of the informal education dedicated to the needs of the adults** the method of the travel expenses is used. The travel destination place (in this case - the infrastructure of the informal education) value calculation algorithm is analogical to the presented in the chapter dedicated to the environmental protection sector (check the benefit component "The increase in the territory's recreational value").

The willingness to pay for the increased availability of the informal education infrastructure, dedicated to provide the extracurricular services to the children firstly must be multiplied by the number of families, which receive the benefit from the investment project, and the obtained value must be included into the costs and benefit part of the analysis, attributing it to the every year during which the informal education classes were provided, up to the period of the ending of analysis. Further the hypothetical example is presented.

[86] According to the data provided by the "Roads and transportation research institute" PI; this value is without the deduction of the indirect taxes, because in this case VMC reflects the willingness to pay.

7 insert. The example of the calculation of the willingness to pay for the increased availability of the informal education structure, dedicated to provide the extracurricular services to the children

Let us say, that because of the created infrastructure the provision of the informal education services was commenced, that will allow to avoid the costs of the child care services, for which parents have to pay, so that the children be taken care of after lessons while parents are at work.

Let us say, that the analysis showed, that such benefit will be received by 30 families per year. Should the analyzed infrastructure be absent, these families would have to hire a private babysitter for 3 hours per day on the average. The babysitter should be hired during the working days, however such services should not be needed for one month during the parental summer vacation. According to this information the average yearly babysitter hiring costs incurred by one family could be calculated. At the price of the babysitter at 6.9 LTL/h and the average number of working days of 21, the average yearly babysitter hiring costs incurred by one family is:

6.9 LTL / h * 3 hours * 11 months * 21 working day / month. = 4,781.7 LTL

The value of the yearly infrastructure's benefit is obtained by multiplying the number of families, that receive the benefit from the avoided average yearly babysitter hiring costs:

30 * 4,781.7 LTL = 143,451 LTL

Source: prepared by the BGI Consulting and the CSIL Milano.

Estimate update instructions

When assessing the willingness to pay for a certain infrastructure dedicated to the needs of adults the estimates of the VMC value and time value are used. The instructions on the update of the estimates of these components are analogical to the updating instructions of the estimates of the corresponding components, provided in the chapter on the sector of transportation.

When assessing the willingness to pay for the infrastructure, dedicated to provide the extracurricular services to children, the value of the willingness to pay for the avoided child care expenses, which could change over the years, is used. It is recommended to renew the value of the benefit component every year. The value applied to the first year of the CBA, is calculated by increasing the value of the year 2013 proportionally to the nominal growth of the GDP per capita (according to the prognosis published by the International Monetary Fund[87]). The values applied to the future years of the CBA, are calculated by increasing the value of the first year of the CBA proportionally to the real growth of the GDP per capita (according to the prognosis of the International Monetary Fund[88]). When performing the survey of such services market, it is recommended to update the value, applied to the first years of the CBA period every five years (when questioning the persons who offer babysitter services in the advertising portals, when contacting the experts of this sphere and so on.).

[87] The source: http://www.imf.org/external/ns/cs.aspx?id=28
IMF prognosis does not include the whole period of economic analysis, therefore, given the occurring uncertainties, the yearly growth pace for the rest of the period is calculated as an average of the growth pace of the yearly GDP per capita during the last five years of the prognosis.

[88] The same.

4. The salary increase due to the improved skills

By contributing to the improvement of the skills of the residents of Lithuania, the investments into the structure of the vocational training (the 3rd type of the projects in the 29 table), studies (the 4th type of the projects in the 29 table) and RDI infrastructure (the 5th type of the projects in the 29 table), should increase the value of the human capital available to Lithuania. This benefit is reflected in the increase in the salary of the people, who achieved a certain level of the education, in comparison with the salary of people without the certain level of the education.

Calculation methodology and calculated estimate value

The formation of the human capital is estimated by the additional gross salary, which is received by the people, whose skills improved due to the system of the education and teaching. The estimate of the benefit component could be expressed in various ways, depending on the level of the analyzed education.

- As the benefit in the case of **the vocational training** is considered the additional salary received by the people, who participated in the vocational training, compared to the salary of the people who differ from the first ones only in the way that they didn't participate in the training organized by the project. The average salary difference for the people with the vocational training and the people without it, but who have the right to acquire it, reflects the economic value of the participation in the vocational trainings. However, in this case one difficulty is mentionable - all people, who have at least the primary education, have the right to get the vocational training. In general the vocational training is available to:
    - The students who have the primary education, by starting to attend the special secondary school, to acquire general secondary education and vocational education at the same time;
    - People with the secondary education, who do not seek higher education and gives the preference to the attendance of the vocational trainings, to acquire a profession (for example, mechanic's, baker's, barber's and so);
    - People of any other age group, who have any education (even from the university) are accepted into the vocational schools.

In the further 34 table is provided the gross yearly salary of the persons with the various level of education in Lithuania (Including the social taxes paid by the employer[89]). The values of the year 2010 published by the Department of Statistics of Lithuania were recalculated into the prices of the year 2013, according to the increase in the average gross salary (I. e. the values of the year 2010 were multiplied by the 2,226.2 LTL, the average gross salary of the year 2013, prognosed by the ministry of the finance and divided by the 1,988.1 LTL, the salary of the year 2010, published[90] by the Department of Statistics of Lithuania).

[89] That comprises additional 31.2% to the average gross salary published by the Department of Statistics of Lithuania.

[90] The table "M3060801: Average monthly salary. Features: sector, year".

Table 34. Gross yearly salary of the persons with the various level of education in Lithuania (year 2013)

	The level of education	Men and women	Men	Women
1	**Total**	**35,048**	**37,851**	**32,579**
2	Primary	18,493	21,737	15,831
3	Basic	22,848	25,140	20,151
4	Secondary	24,329	27,678	20,785
5	Special secondary, including the education with the vocational qualification	26,762	29,247	23,818
6	Higher	49,715	56,714	45,008

Source: composed by the BGI Consulting and the CSIL Milano, according to the data of the table "M3061405: Average gross monthly and average gross hourly salary in the year 2010. Attributes: education, sex" published by the Department of Statistics of Lithuania and the finance ministry prognosis of the average gross monthly salary (http://www.finmin.lt/web/finmin/aktualus_duomenys/makroekonomika).

The increase in the salary of the people, who before the fulfilment of the project had the primary or secondary education and because of the investments into the vocational training infrastructure are acquiring the vocational education, is reflected in the difference of the salaries, which are in the 4th and 5th rows of the table, expressed in the shadow price. For the converting into the shadow price the conversion coefficient of the qualified workforce (0.973) is applicable. The value of the increase in the yearly salary for one person in shadow price is presented in the 35 table below.

Table 55. The increase in the yearly salary[91] of the person with the secondary education (shadow price) after the acquisition of the vocational education (in litai, year 2013)

	Men and women	Men	Women
The yearly increase in the salary by the shadow price	2,367	1,527	2,950

Source: composed by the BGI Consulting and the CSIL Milano, according to the published data of the Department of Statistics of Lithuania.

The calculation of the persons with the higher level of education (for example, bachelor's or master's degree), who decided to participate in the vocational training, increase in the salary cannot be done according to the data provided in the 34 table. For this purpose the different level of the data aggregation is needed. The calculation of the benefit received by the people of any other age group and any other level of education, acquired before the fulfilment of the project, should be based on the research dedicated especially for that (ad hoc), which analyzes the marginal increase in the salary of the people with the

[91]Including the social taxes paid by the employer.

vocational and a higher lever education, in comparison with the salary of the people, who have only the bachelor's degree.

- In the case of **the studies (higher education)** the value of the human capital accumulation is equated to the salary increase in the graduates of the bachelor's, master's or doctoral studies who acquired the higher education diploma, in comparison to the salary of the people who have the education, which is one level lower. Specifically:
  - The salary increase in the bachelor's studies graduate, is calculated as the difference, between his yearly salary and the yearly salary of the person with the secondary education, expressed in the shadow price;
  - The salary increase in the master's studies graduate, is calculated as the difference, between his yearly salary and the yearly salary of the person with the bachelor's degree, expressed in the shadow price;
  - The salary increase in the doctorate studies graduate, is calculated as the difference between his yearly salary and the salary of the doctorate studies graduate, expressed in shadow price.

The data presented in the 34 table is unsuitable for such calculations, because they include only the aggregated average yearly salary of the people who finished the higher education, not discerning the salary of the bachelor from the university, bachelor from the non-university, master or doctorate studies graduates. From all the levels of higher education separate data is available only about the salary of doctorate studies' graduates, when dividing according to the areas of the dissertation. After the establishing with the help of the expert method that the graduates of the master's studies get the salary, which is 70% lower than the doctorate studies graduates, the salary increase after the acquisition of the doctor's degree could be calculated. It is appropriate to supplement the analysis with the sex section: average salary of males and females with higher education (6 row in the 34 table) comprises respectively 114% and 91% of the general average salary of the persons with the higher education. It is believed, that this proportion is applicable and to the graduates of the doctorate and master studies. Below, in the table 36 the estimates of the benefit component are presented, expressed in the shadow price, which was calculated for the observed salary by applying the conversion coefficient of the qualified workforce.

Table 36. The increase in the yearly salary of the person with the master's degree (shadow price) after the acquisition of doctor's degree (in litai, year 2013)

Dissertation field	Men and women	Men	Women
Average	**22,558**	**25,734**	**20,423**
Physical sciences	20,444	23,322	18,508
Engineering and technological sciences	21,812	24,883	19,747
Medical sciences	29,691	33,871	26,880
Agricultural sciences	15,592	17,787	14,116
Social sciences	28,696	32,735	25,979

Dissertation field	Men and women	Men	Women
Humanitarian sciences	17,251	19,679	15,617

Source: composed by the BGI Consulting and the CSIL Milano, according to the published data of the Department of Statistics of Lithuania[92].

- **In the case of the training based on the RDI infrastructure**, when calculating the salary increase in the master's or doctorate graduates who did some kind of studies activities (for example, wrote the thesis) by using the RDI infrastructure, the analogical technique is applied: their salary is compared to the salary of those students, who differ from the first ones only in the way, that they we not participating in the RDI activity. The premise is made, that the students who for the purposes of the studying in the workplace, studies and/or thesis writing used the RDI infrastructure, receive the benefit due to the improvement of their technical and scientific skills. That leaves the mark in their curriculum vitae and reflects in the increase in the salary. However, there is no reliable data about the increase in the master's or doctorate students salary due to the experience, gained while using the RDI infrastructure; this is the unresearched field in theoretical as well as in the empirical literature. More insights to the calculation technique of this benefit could arise in the year 2015 after finishing the currently ongoing research which is financed by the EIB and related to the evaluation of the benefit, which is provided by the RDI infrastructure[93].

Comparison with other countries. The technique provided in here could be applied in any country of the EU. The essential mutual differences of the EU countries in this point of view, covers the yearly salary value differences of the people with the different level of education and the differences of the conversion coefficients, that are dedicated to converting the observed prices into the shadow prices. The level of the students' education, before the vocational training or higher education of the various nature, between countries could vary due to the differences of the education systems. Extensive comparison of the salary increase between the levels of education in the EU member countries is not available, however common practice shows, that the sizes of the salaries correlate with the level of the economic development of each country (measured by the GDP per capita)[94].

Application instructions

The running period of the RDI usually covers 15-20 years, in some cases even more, if the large scope of the technology change is not required. Despite that, people who improved their skills, due to the participation in the scientific practice, they experience the benefit during their whole professional career, which, is believed, will continue even after the termination of the RDI infrastructure's activity. Therefore, despite the project analysis period set by the project's assessor, the residual value of the skills increase benefit, which

[92] The department of statistics. The information about the professional activity of the persons with an academic degree in the years 2009 - 2010.

[93] "Cost/Benefit Analysis in the Research, Development and Innovation Sector", research project funded by the European Investment Bank – University Research Sponsorship Programme (EIBURS). Website: http://www.eiburs.unimi.it/.

[94] For example, from the year 2000 the GDP of Lithuania increased 2.6 times, however the part of the salaries and advances in the structure of the GDP stayed almost unchanged.

occurs outside the limits of the period of the analysis, must be calculated. This residual value should be assigned to the last years of the analysis and properly discounted, according to the rate of the social discount, analogically to the project's material property residual value case.

The residual value of the skills improvement benefit, which manifests outside the limits of the analysis period, is calculated by summing the discounted value of the yearly increase in the salary. The calculation algorithm is analogical to the presented in the chapter dedicated to the health care sector, according to which the value of the statistical living (VSL) is calculated as a sum of the values of the discounted work income, that the individual anticipates to receive until the age of the retirement. For the discount the social rate of the discount calculated for Lithuania 6.15% is applicable.

In order to calculate the residual value of this benefit, it is needed to determine the remainder of the work years, which is left to the project's benefit receiver at the time of the end of analysis, according to the usual retirement age in Lithuania. In the year 2012 this age was equal to 62 years and 8 months for men and 60 years and 4 months for women, but for every later year its increase by 2 months for men and by 4 months for women is anticipated as shown in the table 37 below.

37 table. The usual retirement age in the Lithuania

Year	Men	Women
2012	62.67	60.33
2013	62.83	60.67
2014	63.00	61.00
2015	63.17	61.33
2016	63.33	61.67
2017	63.50	62.00
2018	63.67	62.33
2019	63.83	62.67
2020	64.00	63.00
2021	64.17	63.33
2022	64.33	63.67
2023	64.50	64.00
2024	64.67	64.33
2025	64.83	64.67
2026	65.00	65.00

Source: prepared by the BGI Consulting and the CSIL Milano.

Estimate update instructions

It is recommended to update the values of the estimates of the increase in the salary every year, while considering the salary changes of the different education groups and the values of the conversion coefficients that were valid at the moment of the update. Also it is appropriate to make the updates of the values when more accurate or more disaggregated data of salary becomes available. The values applied to the first year of the CBA period are calculated by increasing the value of the first CBA year proportionally to the real growth of the GDP per capita (according to the statistics published by the International Monetary Fund[95]).

5. The value of the knowledge creation (the benefit of the scientific publication preparation)

The infrastructure of the RDI is firstly dedicated to the creation of the new knowledge about the new fundamental scientific principles. The value of the knowledge creation is obtained by adding two elements: the value of the scientific publications published by the scientists working in the RDI infrastructure, i.e. the economic value of the scientific production and the economic value of the scientific publications quotation. The calculation technique of the first component is given in this subsection, the technique of the second in the other subsection.

Calculation methodology and calculated estimate value

Part of the knowledge creation value could be equated to the economic value of the scientific publications published by the scientists engaged in the research activity in the RDI infrastructure.

The value of the scientific publication in the practice of the CBA often was measured by the traditional economic value[96]. However JASPERS and EIB considers this point of view to be criticizable, because such point of view is not based on the solid theoretical CBA basis. EIB institute expressed the need to develop a more durable CBA technique for the research infrastructure and entrusted this task to the team of researchers, which include the University of Milan and the service provider "CSIL"[97].

Based on the theoretical foundation of the CBA and the preliminary conceptualization of the economic benefit of the research infrastructure, performed by the team of EIB researchers, the value of the scientific publication could be evaluated as:

- The willingness of the scientists to pay for the preparation of publications. In order to find out the preferences and determine the economic value that scientists attribute to the publications, the evaluation of the contingent is applicable.
- The alternate costs of the scientists' time, that is needed to conduct and prepare the publication.

Because the estimate of the scientist's willingness to pay for the preparation of the publication is unavailable, it is suggested to rely on the second method, which suggests to determine the value of the scientific publication according to its marginal preparation costs. They are reflected by the average compensation received by the scientist for the time that was dedicated to the preparation of the publication.

The formula (V_p) for calculation of the marginal economic value of one publication includes the average yearly gross salary of the scientist (w_L) in Lithuania, the amount of time (t)in percentage dedicated by a

[95] The source: http://www.imf.org/external/ns/cs.aspx?id=28. IMF prognosis does not include the whole period of economic analysis, therefore, given the occurring uncertainties, the yearly growth pace for the rest of the period is calculated as an average of the growth pace of the yearly GDP per capita during the last five years of the prognosis.

[96] JASPERS (2013) "Project preparation and CBA of RDI infrastructure projects", Staff Working Paper, JASPERS Knowledge Economy and Energy Division.

[97] The web page of the project is available at the address http://www.eiburs.unimi.it/.

scientist to the research (the other time is usually dedicated to teaching) and the number of publications (p) prepared by the scientist per year:

$$V_p = \frac{w_L \cdot t}{p_L}.$$

For example, when making the assumption, that the scientist working in the RDI infrastructure, dedicates 50 % of his time to the research and the generation of the new scientific knowledge[98], , and by knowing, that average yearly gross[99] salary of the scientist in Lithuania is 43,998[100] LTL in the prices of the year 2013 (expressed in the shadow prices after the application of the conversion coefficient of the qualified workforce), and also that the scientist writes approximately 1.36 publications[101], per year, economic value of one publication could be determined:

$$V_p = \frac{43\,998 \cdot 50\%}{1{,}36} = 16\,201 \approx 16\,000$$

After the round off it is equal to 16,000 LTL for one publication in the prices of the year 2013.

The estimate of the benefit component can be specified more accurately and brought closer to the context of the specific project, by applying the average salary of the scientists working in the specific area of the research (e.g. physics, biomedicine, nature sciences, social sciences and so on) in which the evaluated RDI project is conducted and concrete average yearly number of publications in the research area that is relevant to the project. The number of publications, prepared by the scientists who work in the various spheres of the research, differ (as we can see from the survey performed by the Italy, results of which are presented in the 3 appendix of the sector).

Comparison with other countries. The average salary of the professionals who work in the sphere of the scientific research and development in the different countries is not the same. The value of the scientist's salary in Lithuania as in the rest of the Eastern Europe is lower than the EU's average. The average number of publications written by the scientists of Lithuania per year does not reach the average of the EU as well, which is 2,31 publications per scientist. These gaps reflect the differences of the marginal value of the scientific publication between the EU's countries.

Application instructions

In order to calculate the economic value of the scientific publications' preparation benefit component it is necessary to anticipate the expected number of the scientific publications prepared by the scientists, that work with the RDI infrastructure. The yearly value of the benefit component is obtained by multiplying the number of all publications prepared during the year by the scientists, which work with the RDI infrastructure, from the marginal costs of the publication preparation.

[98] It is appropriate to make such an assumption, because more accurate data is not available.

[99] Including the social taxes paid by the employer.

[100] According to the data of the Department of Statistics of Lithuania table "M3060838: Average monthly salary and other indexes. Features: the type of economic activity (CTEA 2) sector, year", about the average gross salary of the economic activity "M72 Scientific research and applicable activity", including the social taxes paid by the employer and after recalculation into the prices of the year 2013.

[101] RHEMAC calculations.

If making the assumption, that scientists dedicate 50% of their time to the research and is also assumed that during the year they prepare 1.36 publications (corresponds with the national average), also is expected, that a 100 scientists will work with the RDI infrastructure, the economic value of the preparation of publications per year is equal to:

$$16{,}000*1.36*100= 2{,}176{,}000 \text{ LTL.}$$

This benefit should be attributed to each year until the end of the period of the project analysis.

It is necessary to emphasize, that the scientists, who work in the RDI infrastructure are the users of knowledge (benefit receivers) as well as creators of knowledge (scientific production). The shadow costs of the scientists work in the performed analysis are included into the part of the costs. This allows to think, that yearly costs of the scientists work are balanced by the economic benefit of knowledge, created by the same scientists. If the assumption is made, that scientists always work in the research activity (do not conduct any teaching activity, that's why in the formula provided above $t = 100\%$), all their yearly time costs in the conducted analysis must be included into the part of the benefit. So, the costs of the scientists work and the value of publications' preparation in the CBA would cancel each other.

Estimate update instructions

International technique dedicated to the calculation of the economic value of the publication, is still being developed and it is likely that it will be prepared until the end of the year 2015[102]. The calculation technique described in this chapter is considered valid until the year 2015. After that it is really recommended to review it, in order to consider any methodological improvements.

The deepening of the technique could provide for example the following aspects:

- Bibliometric methods that analyze the created scientific literature and average number of quotes of the publications of the specific sphere of science, could help to forecast in advance the amount of the scientific production, which is related to the RDI infrastructure. Updated technique could specify how to utilize the bibliometric methods in practice and reliably forecast the number of the additional publications prepared due to the project of the RDI infrastructure.
- The results of the tests performed by using the RDI infrastructure could prompt the preparation of the scientific publications even after the termination of the project. That should mean, that the benefit would continue by exceeding the time horizon of the project and that the residual value of the knowledge benefit must be calculated, which must be included into the final year of the time horizon. In the updated technique this aspect could be developed more deeply, for example, could be offered the use of the bibliometric methods in order to foresee the dynamics of the knowledge creation in time.
- Could be researched if the creation of the knowledge that is attributed to the RDI infrastructure is limited only to the publications prepared by the scientists who use the infrastructure, i.e. those who directly conduct RDI activities, or it does it spread and among other scientists, who do not use the infrastructure, but develop the knowledge created by the scientists who use the infrastructure, and prepare the publications of their own by quoting the scientists, who use the infrastructure. That should mean, that not only the value of the quotation should be calculated (as presented in

[102]The web page of the project is available at the address http://www.eiburs.unimi.it/.

the later section) but also the alternative costs of time, which is dedicated to the preparation of the quoted publication. In other words, the value of the publications prepared by the scientists, who use the infrastructure could in some way be added to the value of the publications prepared by the external scientists, reflecting it by the full costs of the time of the researched activities, dedicated to prepare the quoted publications.

- In such way the updated technique could present the currently unavailable values of the scientists' salaries and average number of the prepared publications according to the sphere of science or dissertation.

6. The value of the knowledge creation (the benefit of the scientific publications quotation)

Alongside the value of the scientific publications the economic value could be attributed and to the recognition and honor given by the scientific community to the scientific production, those are reflected by the number of instances when the publication was quoted. After the economic value of the quotation is added to the value of the pure knowledge creation (calculated based on the marginal costs of the publication's preparation, as presented in the aforementioned chapter), the bigger value of the knowledge creation could be attributed to the original publication, that presents genial new ideas when compared with the less useful and less influential publication. Relying on the citations as the measurement unit of the importance of the scientific publication is widely accepted method[103].

Calculation methodology and calculated estimate value

The shadow price of the quotation must be calculated, it could be expressed as:

- The willingness to pay by the scientists, so that their works would be quoted. Because quoting is free, there is no reliable system of prices, which would allow to evaluate this asset. Therefore, in order to find out the preferences and determine the economic value attributed by the scientists to the quotation, the evaluation of the contingent is needed.
- The alternative costs of the scientists' time, which is dedicated to the preparation of their own publications, in which the publications of the scientists who use the RDI infrastructure are quoted.

Because the evaluation of the contingent is unavailable in this case, it is appropriate to assess the value of the quotation analogically to the value of the publication preparation, based on the alternative costs. The economic value of the scientist's time, that is dedicated to read and understand the publication of somebody else and to decide if or how to quote it, reflects on the scientist's compensation received for his work, i.e. on his salary. This time could vary from two to more hours or even a few days, depending on the type of the quoted publication, its size, theme, experience when quoting other scientists and other variables.

[103]Hagström, W. (1965). The Scientific Community, New York: Basic Books; De Solla Price, D. J. (1970). 'Citation Measures of Hard Science, Soft Science, Technology, and Non Science', in C.E. Nelson and D.K. Pollack (eds) Communication among Scientists and Engineers. Lexington, MA: Heath, 3-22; JASPERS (2013) "Project preparation and CBA of RDI infrastructure projects", Staff Working Paper, JASPERS Knowledge Economy and Energy Division.

The value of the quotation (V_c)is obtained by using the further provided formula, in which w_h is scientist's gross hourly salary and is the number of hours, that is needed to read the publication and decide if or how to quote it:

$$V_c = w_h \cdot h \, .$$

It should be noted that w_h reflects not the salary in Lithuania but the average salary of all scientists that can quote the publication of the Lithuanian scientist. In the ideal case the former would include scientists from any country of the world. The assumption is made, that Lithuanian publications are usually quoted by the European scientists and researchers. Considering that the scientist's average gross salary in the EU is about 138,550 LTL (40,126 EUR)[104], and presuming that 1 equal conversion coefficient is applied, the hourly shadow salary of the scientist in the EU would be equal to about 67 LTL. By thinking, that time needed for the quotation usually is 12 hours, the value of the quotation is approximately equal to 800 LTL for one quote.

In order to calculate the yearly benefit related to the quotation value, it would be needed to determine the number of the quotation instances for each Lithuanian publication per year. This number depends from many factors, such as the history of scientist's achievements, scientific management and general strategy of the research (conducted while using the RDI infrastructure), the competitive point of view of the scientists and devotion, also luck when choosing the "right" experiments and the parameters of the research equipment, which influence the possibility of discovery. The number of quotation instances usually varies depending on the sphere of the research.

In the table 38 bellow, the image data about the quotation of the publications, that were published in the magazines. This data reflects not the Lithuania's case specifically, but includes the information accumulated in the Essential Science Indicators database, about the published publications quotation instances during the 2000-2010. The assessor of the project could rely on these quotation averages, if they could be treated as realistic in the context of the specific project that is being assessed.

38 table. The examples of the average number of the quotation instances of one publication according to the sphere of the science

Scientific field	The average of the year 2000 - 2010
All areas	**10.81**
Molecular biology	25.62
Immunology	21.81
Neurosciences	19.47
Biochemistry	17.25
Microbiology	15.79
Space-science	14.30
Clinical medicine	12.93
Pharmacology	12.20

[104]The source: European Commission (2007), "Remuneration of researchers in the public and private sectors", Final report (http://ec.europa.eu/euraxess/pdf/research_policies/final_report.pdf).

Scientific field	The average of the year 2000 - 2010
Environmental protection / ecology	11.35
Psychiatry / psychology	11.26
Chemistry	11.19
Earth sciences	9.70
Physics	8.97
Plant / animal sciences	7.74
Agricultural sciences	7.05
Materials science	7.03
Economics / business	6.22
Engineering	4.76
Social sciences, other	4.67
Informatics	3.75
Mathematics	3.48

Source: composed by the BGI Consulting and the CSIL Milano according to the data of the Times (http://www.timeshighereducation.co.uk/415643.article)

Comparison with other countries. The average salary of the specialists, who work in the sphere of the scientific research and development, is not the same in the different countries. Specifically the salary in Lithuania is lower than EU's average. However, because quotation could be done by the scientists in any country, the average salary valid in all countries could be applied for the calculation of the quotation's alternative costs. When evaluating the quotation of the Lithuanian publications the average salary in the EU was taken into the consideration. If were relied on the salary in the US, the value of the quotation were higher due to the bigger yearly salary of the scientists in this country.

Application instructions

When seeking to calculate the benefit of the quotation, which occurred as a consequence of the projects of the RDI infrastructure, the following data is needed:

1. **The number of publications prepared by all the scientists who use the RDI infrastructure:** as mentioned in the aforementioned section, it could be determined by doing the comparison with the other similar RDI infrastructure.
2. **The number of quotation instances of each publication prepared by the Lithuanian scientists:** it could be calculated by using the bibliometric data specifically applied to the context of Lithuania or the bibliometric data transferred (as shown, for example, in the 38 table) from other studies.
3. **The economic value of one citation.**

After multiplying the likely average number of the quotation instances of every Lithuanian publication by the total number of publications prepared by the scientists, is obtained the general number of the quotation instances of the publications prepared by the Lithuanian scientists who use the RDI infrastructure. Then this number is multiplied by the economic value of the quotation (800 LTL for one quote), to obtain the yearly economic value of the quotation.

The total value of the created knowledge is calculated by adding the economic value of the quotation and the economic value of the publications prepared by the Lithuanian scientists who use the RDI infrastructure.

Estimate update instructions

The international technique dedicated to the calculation of the economic value of the publication quotation, is still being developed and it is likely, that it will be prepared until the end of the year 2015 [105]. The calculation technique described in this chapter is considered valid until the year 2015. After that it is really recommended to review it, in order to consider any methodological improvements.

At the time of the review of the technique, could be set, for example, the average number of the quotation instances of the Lithuanian publication, which could be differentiated accordingly to the sphere of science.

7. The value of the innovative activity commercialization

Although the main product of the RDI infrastructure, that is aimed at the research activity is knowledge, the RDI infrastructure of this type could also create and other products, which should be evaluated appropriately by conducting the economic analysis of the projects of the RDI infrastructure.

Calculation methodology and calculated estimate value

The results of the innovative activity, which have economic value are:

- **The services sold to the third parties by the manager of the RDI infrastructure.** The manager of the RDI infrastructure could sign the contracts for testing, prototype creation or provision of other services to its clients. The income received from companies due to the use of the specific RDI services, dedicated to the commercialization of the new products or services, reflects the benefit of the infrastructure. The value of these services should be calculated as the clients' willingness to pay for the services provided by the RDI infrastructure. However, such estimates of the willingness to pay are not available in Lithuania, nor in any other country, therefore the assumption is made, that the **observed market value** of these services is not distorted and due to that can express the real economic value of the services.
- **The transactions of the licenses.** The RDI activity could cover the application and granting of the national and international patents. The value of the scientific or technological innovations is considered to be related to the factual use of the patents and real social economic benefit. Therefore the only practical application of the intellectual property is considered as a social benefit, i.e. in this case the return created by the transactions of the licenses. The patent granted on the basis of the RDI infrastructure is not an economic value in itself, while it is not sold and stays unused.

[105]The web page of the project is available at the address http://www.eiburs.unimi.it/.

Factual average commercial value of the patent in Lithuania is unknown, partly because of the fact, that commercialization of the innovative activity results in the country is still limited. In the research conducted by the OSCE in 2003 [106] is shown the variety of the income from one sold license:

"Despite the fact that some of the public research organization generates several millions of US dollars from the licenses in the US, the average value of one publication in the year 2,000 was 150,000 US dollars.

In Switzerland the average income from the selling of one license is much smaller and equal to 45 000 EUR.

According to the EIB [107], the average yearly income from one license in Germany is 55,000 EUR, and higher average value (200,000 EUR) falls to the licenses of the Max Planck institute. In the Lithuania's case the economic values of the licenses' transactions are not available. However the assessor of the project could create the estimate of this benefit component by comparing the assessed RDI infrastructure with similar RDI infrastructure in other countries, in which the data about the average market price of the licenses transactions are is available.

Comparison with other countries. The commercialization of the innovative activity is undeveloped in Lithuania, therefore it is considered, that the value of this benefit is much smaller than in the other countries of Europe. However, it is noted that the value of the transactions of the services and licenses selling to the third countries varies very much, not only between countries but also depending on the specific structure of the RDI.

Application instructions

When calculating the benefit associated with the services provided by the RDI manager to his clients, the income, expressed in the observed market prices, could be used in the economic analysis as well without the application of any conversion coefficients. The maintenance costs, incurred by the manager of the RDI infrastructure when providing services, should also be included into the CBA (into the costs).

When analyzing the benefit associated with the selling of the patents, the value of the likely commercialized patents should be included into the benefit of the project in the year, during which the license transactions are prepared, and the income from such transaction is expected. Similarly as in the case of the value of the sold services, the assessor of the project should take into the consideration that besides the income received from the selling of the patent license, the manager of the RDI incurs certain expenses as well, due to the acquisition of patents and their upkeep (before the selling of the license). Such costs in the performed analysis should be included into the part of costs.

Estimate update instructions

Because singular values of the license transactions are not suggested to Lithuania, instructions for their update are not presented as well. Such values could be collected by the assessor of the project by making a comparison with the similar RDI infrastructure in other countries, considering the specific characteristics of the assessed RDI infrastructure.

[106] OSCE „Turning science into business“ (2003)

[107] EIB – European Investment Bank (2013), “The Economic Appraisal of Investment projects at the EIB”, Luxembourg.

8. The economic value of the spin-off companies

The RDI infrastructure often prompts the establishment of the new companies, which seek to further develop and commercialize the results of the innovative activity of the project.

Such spin-off companies reflect the positive technological outside effect of the RDI infrastructure.

Even if the creation of the jobs is considered the main economic benefit, occurring due to the creation of the new business subjects, from the perspective of the CBA, the real socio-economic benefit, which has to be appreciated, is the economic profit generated by the new companies [108].

Calculation methodology and calculated estimate value

The economic value of the creation of the spin-off company is reflected by the total profit of the company, earned during the period of the company's operation, compared to the counterfactual situation with the zero money flow. From the perspective of the ex post, the return of the sales given in the balance of the company, could be used as a measurement for the social profit, by making the assumption, that operating in the conditions of the competitive market. However, in the *ex-ante* case the estimate of the profit, expected by the spin-off companies, needs to be created.

For this purpose the average profit (before taxes) of the companies operating in the high technology sector is used as the estimate of the profit expected by the RDI of spin-off companies. Official statistics are available only for the companies, which operate in the two branches of business: companies that participate in the production and commercialization of the pharmaceuticals and preparations (CTEA code C21) and for the companies, which work with the computers, electronic and optical products (CTEA code C26). Considering the large variety of the earned profit in each of these sectors in the recent years, the average of the 2007-2012 period is used. That is equal to:

- For the companies, that produce the **main pharmaceutical products and preparations**: **1,582 K LTL**;
- For the companies, that produce the **computer, electronic and optical products**: **493 K LTL**[109].

These two branches of business usually include the majority of the spin-off companies, which originate from the RDI projects [110]. If the analyzed companies cannot be assigned to neither of these branches, their expected profit must be assessed by the tests, especially, *ad hoc*, dedicated, for that purpose. As an alternative, if it is considered appropriate, the expected profit could be evaluated as the simple average of the profit of the aforementioned CTEA activities C21 and C26.

Comparison with other countries. General profitability of the companies, that operate in the branches of the high technology industry and provide the services susceptible to the knowledge, during the recent years in Lithuania significantly increased and reached the level of other EU countries. However the significant differences in the profit of the high technology companies between the different countries of

[108] Economic profit from the financial profit differs in the way, that when calculating the economic profit, the alternative costs of the resources used to conduct the activity are evaluated.

[109] Calculated according to the data of the Department of Statistics of Lithuania table "M4030006: The income, expenditure, profit of the companies. Features: type of the economic activity (CTEA 2)".

[110] Such statement is corroborated, for example by the further specified sources: https://www.ethz.ch/content/dam/ethz/main/industry-and-society/transfer/dokumente/ETH_Zurich_spin-offs.pdf; http://www.oecd.org/science/sci-tech/introductionthenewspinonspin-offs.htm.

the EU still exist. Despite the fact that an extensive comparison of the EU countries is not available, the general experience shows, that in the countries with the longer traditions of innovations (e.g. in Germany) the high technology companies usually receive bigger yearly profit and operate longer.

Application instructions

The estimate of the economic value of the spin-off companies, which were established due to the RDI infrastructure, is based on the value of the yearly general profit earned by the spin-off companies from their establishment till their dissolution. Specifically, several steps must be taken:

- To predict the number of spin-off companies the will likely be established due to the creation and usage of the RDI infrastructure. Such prediction should rely on the expert opinion and probably on the comparison with the similar RDI infrastructure in the same country or abroad.
- To predict and justify the probable general yearly profit of each spin-off company. The value of the yearly profit presented in this chapter could be applied to the budding companies, which operate in the spheres of the pharmacy or IT, in the spheres of the electronics and optics.
- To predict the average expectancy of life (expressed in years) of the high technology companies in Lithuania and to justify it, for example by referring to the comparison with the other similar companies of the high technologies.
- Despite the year of the time horizon, during which the spin-off company is established, the benefit should be calculated for the total period during which company operated. Due to that it is believed that a part of the benefit will continue and after the final year of the RDI project's time horizon. A person, who is performing the analysis of the project should make sure, that the residual value, attributed to the final year of the analysis time horizon, includes not only the residual value of the project's material property, but also and the residual benefit, appropriately discounted accordingly to the discount's social rate. The calculation algorithm of the residual value is analogical to the calculation algorithm of the skills improvement benefit, which occurs outside the time frame of the analysis (check the benefit component “the increase in the salary achieved due to the improved skills”).

Estimate update instructions

The value of the profit of the high technology companies during different years varies. In order to soften such volatility, it is recommended to rely on the average profit of many years. The singular values offered in this chapter are calculated as the averages of the period of 2007-2012. It is recommended to update the estimates of the benefit component every year. The value of the component's estimate applied to the first year of the CBA, is calculated accordingly to aforementioned instructions, calculating average profit as the average of the newer values (e.g. by taking the period of the 2008-2013 when calculations are made in the year 2014). The values applied to the future years of the CBA, are calculated by increasing the value of the first year of the CBA proportionally to the real growth of the GDP per capita (according to the prognosis of the International Monetary Fund [111]).

Furthermore, when the data about the profit received by the high technology companies that belong to the additional CTEA economic activities becomes available, the estimates of the benefit component presented in this section, calculated for the companies operating in the CTEA economic activities C21 and C26, should be supplemented by the estimates, that are applicable to the additional economic activities of the CTEA (calculated in accordance with the aforementioned instructions).

[111] The source: http://www.imf.org/external/ns/cs.aspx?id=28. IMF prognosis does not include the whole period of economic analysis, therefore, given the occurring uncertainties, the yearly growth pace for the rest of the period is calculated as an average of the growth pace of the yearly GDP per capita during the last five years of the prognosis.

1.3.4. Table of socio-economic impact estimates in education and science sector

In summary, determined socio-economic impact estimates are presented in Terms of Reference in a tabular form (Table 6). According to the requirements of the Terms of Reference, the table of indicators should be linked to the conversion coefficients determined by the services provider, in order to ensure that there will not be double-counting in calculations. However, none of the established estimates is related to conversion coefficients applicable under the determined conditions, so there is no risk of double-counting.

Table 7. Socio-economic impact estimates determined for the education and research sector

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload *(table of strong, reliable and significant ratings (at least three))*	Quantitative expression, Lt
Education and science	N/a[112]	N/a	1. Willingness to pay for the increased availability of pre-school education services	• Avoided private kindergarten costs: 833 LTL per month, 9,167 LTL per year • Avoided home visiting nurses expenses: 1,241 LTL per month, 13,656 LTL per year • Avoided losses of the created product: 2,562 LTL per month, 30,313 LTL per year
Education and science	N/a	N/a	2. Willingness to pay for the improved educational infrastructure and quality of service	In case of public education infrastructure: • 4,560 LTL per year both for primary and secondary schools In case of infrastructure used for private educational services: • Primary schools: 7,943 LTL per year, from which the annual fee must be deducted payable in case of scenario „without the project implementation“ • Secondary schools: : 9,835 LTL per year, from which the annual fee must be deducted payable in case of scenario „without the project implementation“

Education and science	N/a	N/a	3. Willingness to pay for the increased availability of non-formal education	• Avoided nanny recruitment costs: 6.9 LTL per hour
				• If the willingness to pay is assessed by the method of the travel costs:
				  • time value for non-work passengers travelling: 11.73 LTL/h
				  • vehicle operating costs value applied in

[112] Not applicable.

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload (table of strong, reliable and significant ratings (at least three))</th><th>Quantitative expression, Lt</th></tr>
<tr><td></td><td></td><td></td><td>services</td><td>Lithuania: 0.83 LTL/km
the average number of persons travelling by cars in Lithuania: 1.2 passengers in a car.</td></tr>
<tr><td>Education and science</td><td>N/a</td><td>N/a</td><td>4. Increase in wages achieved due to the improved skills</td><td>The value applied to vocational training: on average 2,367 LTL (1,527 LTL for men and 2,950 LTL for women).
The benefit for science doctoral degree:
<table>
<tr><th>Dissertation area</th><th>Men and women, LTL</th><th>Men, LTL</th><th>Women, LTL</th></tr>
<tr><td>Average</td><td>22,558</td><td>25,734</td><td>20,423</td></tr>
<tr><td>Physical sciences</td><td>20,444</td><td>23,322</td><td>1,508</td></tr>
<tr><td>Engineering and technological sciences</td><td>21,812</td><td>24,883</td><td>19,747</td></tr>
<tr><td>Medical sciences</td><td>29,691</td><td>33,871</td><td>26,880</td></tr>
<tr><td>Agricultural sciences</td><td>15,592</td><td>17,787</td><td>14,116</td></tr>
<tr><td>Social sciences</td><td>28,696</td><td>32,735</td><td>25,979</td></tr>
<tr><td>Humanities</td><td>17,251</td><td>19,679</td><td>15,617</td></tr>
</table></td></tr>
<tr><td>Education and science</td><td>N/a</td><td>N/a</td><td>5. The value of knowledge creation (benefit of the research publications' preparation)</td><td>Assuming that a researcher prepare an annual average of 1.36 publications and allocate 50% of his time for research, economic value is equal to 16,000 LTL per publication
Under other assumptions, the formula presented in the descriptive part of the estimate is used.</td></tr>
<tr><td>Education and science</td><td>N/a</td><td>N/a</td><td>6. The value of the knowledge creation (benefit of the research publications' citation)</td><td>800 LTL per citation</td></tr>
<tr><td>Education and science</td><td>N/a</td><td>N/a</td><td>7. Innovative performance commercializatio n value</td><td>The economic value of the services sold: equal to the market value of the sold services
The economic value of the licences transfer: estimated on the basis of comparative values available to the existing similar RDI infrastructure in Lithuania and other countries.</td></tr>
<tr><td>Education and science</td><td>N/a</td><td>N/a</td><td>8. Spin-off companies economic value</td><td>1,582 thousand per year for the spin-off companies involved in manufacture of basic pharmaceutical products and pharmaceutical preparations
493 thousand LTL per year for the spin-off companies involved in manufacture of computer, electronic and optical products.</td></tr>
</table>

Notes:

* The table of indicators should be associated with the conversion coefficients established by the services provider, in order to ensure that there will not be double-counting of benefits and harms in calculation.

1.3.5. Annexes (education and science sector)

Annex 1. Benefit (damage) components applied to different types of projects

Project type	Applied benefit (damage) components
1. Investment in pre-school infrastructure and environmental modernization	1. Willingness to pay for the increased availability of pre-school education services
2. Investment in general education infrastructure and environmental modernization	2. Willingness to pay for the improved educational infrastructure and quality of service
3. Investment in vocational education infrastructure and environmental modernization	4. Increase in wages achieved due to the improved skills
4. Investment in studies infrastructure and environmental modernization	4. Increase in wages achieved due to the improved skills
5. Investment in RDI infrastructure and environmental modernization	4. Increase in wages achieved due to the improved skills 5. The value of knowledge creation (benefit of the research publications‘ preparation) 6. The value of the knowledge creation (benefit of the research publications‘ citation) 7. Innovative performance commercialization value 8. Spin-off companies economic value
6. Investment in non-formal education infrastructure and environmental modernization	3. Willingness to pay for the increased availability of non-formal education services

Annex No. 1 Description of the main provisions for estimation of the benefit (damage) component “1. Willingness to pay for the increased availability of pre-school education services”

In order to determine the value of availability of pre-school education services, a method of willingness to pay for the service was used. An approach of avoided cash is applied, in which the willingness to pay for the public services is expressed by avoided costs which could have been incurred by using alternative more expensive suppliers of the same service (in this case, private kindergarten or private babysitter at home). On this basis, for the calculation of benefit (damage) estimate the method of the market prices examination was used. Services fees of private kindergartens (legal persons who have the right to engage in such activities) are available on the websites or by sending an official inquiry in writing. It is recommended to perform monitoring of prices private babysitters by sending queries to the nanny agencies or by monitoring the prices published on the specialised websites intended for babysitting services. Usually, there are published hourly babysitting services fees. If the published information covers other than the calculated time interval, then it is recommended to re-calculate it to the hourly fee.

In order to determine average fee of a private kindergarten or a private babysitter at home, which would be applied for the purposes of the estimates calculation, it is recommended to collect information about the prices of at least 15 different services suppliers. If there is a possibility, it is recommended to choose a bigger number of observations (20-30). Price examination must cover at least some of the information sources (i. e. different internet portals, internet portals of different legal persons). For the price survey it is important to follow these principal positions:

- Before performing the surveillance, to clearly define the service and its components (i. e. there are cases when a private babysitter at home performs more functions and tasks, therefore, it is important to narrow the definition of services to direct functions related to the childcare);
- Observing the market price, it is important to ensure that the proposed service meets the definition of service;
- Observing the market price it is important to ensure that the information is relevant, real and reliable (for example, published on recognized websites functioning for a long term);
- After the observations it is recommended to eliminate the minimum and maximum values from the further calculations;
- The final prices examination result is calculated as a simple average of the prices observed.

When the examination of prices is based on the prices of services provided in the city of Vilnius, the calculated observed prices should be converted to the values applicable to the whole Lithuania. For this purpose, the coefficient reflecting the ratio between the monthly gross salary in the Republic of Lithuania and the City of Vilnius is applied (in accordance with the table of Lithuanian Department of Statistics “M3060838: >>>Average monthly gross and net wages. Administrative territory data).

Annex No. 2. The annual number of publications in Italy by a variety of research areas

The number of publications prepared by scientists working in various areas is different. The table below presents results of the newest research performed by Italian National Universities and Research Institutes Agency (2013): the number of publications prepared by Italian professors varies from 1.39 in the field of civil engineering and 8.69 in the field of physics[113]. These values are much too high for Lithuania, but they confirm the existence of big variation of publications prepared in a year.

Table 1 . The annual number of publications in Italy by a variety of research fields

Research field	Average annual number of publications
Mathematics and informatics	2.23
Physics	8.69
Chemistry	8.51
Earth sciences	3.55
Biology	5.34
Medicine sciences	8.56
Agriculture and animal sciences	3.69
Civil engineering	1.39
Industrial and information engineering	3.17
History, philosophy and psychology sciences	2.28

Source: developed according to the data of BGI Consulting and CSIL Milano National Universities and Research Institutes Agency (2013) available on the internet: http://abilitazione.miur.it/public/documenti/Tabella_1_mediane_candidati_commissari.pdf.

[113] In the field of physics the number of co-authors of one publication is generally higher than in other disciplines, so the annual number of publications for one physician is higher.

1.4. Transport

1.4.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.4.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

Selection of benefit (damage) components has been based on the approved list of typical transport sector projects (see Table 40).

Table 8. Breakdown of General Transport Sector Project Types

Project Type	Project Examples
1. Development of rail transport	1.1. Reconstruction of railway lines (construction and reconstruction of railway tracks, modernisation of signalling, energy supply equipment, traffic management systems; electrification of railway network) 1.2. Reconstruction of stations 1.3. Acquisition of vehicles
2. Development of road transport	2.2. Construction and reconstruction of state roads 2.3. Reconstruction of local roads and streets
3. Development of water transport	3.1. Improvement of Klaipėda Seaport infrastructure characteristics
4. Development of air transport	4.1. Modernisation of airport infrastructure
5. Public transport	5.1. Acquisition of green vehicles

Source: Compiled by BGI Consulting and CSIL Milano according to the information provided by SFMIS, strategic planning documents and the Ministry of Transport and Communications of the Republic of Lithuania.

The main benefit of all transport projects is reduction of overall costs of freight and passenger transport.

Overall transport costs mean inconveniences suffered by a transport user while travelling from a travel origin point *(i)* to a travel destination point *(j)* by certain means of transport. In practice overall transport costs are usually estimated by adding monetary costs (for example, rates and vehicle operational costs) and travel time value calculated in respective monetary units.

Thus, based on the definition of overall transport costs, transport projects bring the following typical direct benefit:

- Time savings of freight and passenger transport,
- Vehicle operational costs savings for road users.

The main external impact related to transport projects includes:

- Reduction of road accidents,
- Reduction / increase in noise pollution,
- Reduction / increase in air pollution,
- Reduction / increase in greenhouse gas emission.

The last three are considered to be external environmental impacts.

Detailed arguments for selection of benefit (damage) components are presented in the table below.

Table 9. Arguments for Selection of Benefit (damage) Components

Component	Types	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Time savings	Direct impact	In the available methodological documents [114] and studies time savings of freight and passenger transport are distinguished as one of two types of direct impact manifested in transport projects. This has also been highlighted in the European Commission Guidelines 2008. Besides, empirical cases of cost benefit analysis, reflecting both Lithuanian[115], and foreign [116] transport projects, treat this impact as one of the biggest benefits. Distinction of this direct impact also complies with the EU and national strategic provisions, emphasizing the need to reduce transport congestions and make transportation time[117], shorter what means freight and passenger transport time savings. Component estimates may be also applied in estimating time losses, rising, for example, during project implementation.
2. Road vehicle operational	Direct impact	In the available methodological documents and studies vehicle operational costs savings are distinguished as one of two types of direct impact

[114]Such as: European Investment Bank, (2013)The Economic Appraisal of Investment Projects at the EIB; JASPERS Blue Book, (2008), Road Infrastructure; or at national level: French Ministry of Transport's (2005) Harmonisation des méthodes d'évaluation des grands projets d'infrastructures de transport; HM Treasury, (2003) Appraisal and evaluation in Central Government. The Green Book, Treasury Guidance, etc.

[115]For example, Development of the Trans-European network roads E85 (Vilnius–Lyda) and E272 (Vilnius–Panevėžys–Šiauliai–Palanga): reconstruction of the section Šiauliai-Radviliškis of the road Panevėžys–Šiauliai (stage I).

[116]For example, the highway A23 in Spain (sections of which have been financed from the Cohesion Fund of 2000–2006); for more details see Ex Post Evaluation for Cohesion Fund (including former ISPA) 2000-2006 - Work Package B: Cost benefit analysis of selected transport projects.

[117]For example, Strategy of Long-term Development of the Lithuanian Transport System (up to 2025).

Component	Types	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
costs savings		manifested in transport projects. This has been also highlighted in the European Commission Guidelines 2008. Empirical cases of cost benefit analysis, reflecting both Lithuanian[118], and foreign transport projects, treat this impact as a significant benefit. Distinction of this direct impact also complies with the EU and national strategic provisions, emphasizing the need to reduce energy consumption in the transport sector[119]. Besides, the predicted growth of mobility and volumes of freight transported also reveals the importance of reduction of fuel consumption and other operational costs.
3. Reduction of road accidents	External impact	Reduction of road accidents is one of the main strategic goals both in the EU and in Lithuania. For example, number of fatalities has been presented as an assessment criterion in the National Progress programme. A large number of fatalities on Lithuanian roads are still considered to be one of the biggest problems. Reduction of road accidents is usually presented as a significant benefit in empirical cases of cost benefit analysis, reflecting both Lithuanian[120], and foreign [121] transport projects. Component estimates may be also applied in estimating accident costs, rising, for instance, in case when number of road accidents increases together with transport flows increased due to project implementation.
4. Reduction of noise pollution	External environmental impact	Reduction of external environmental impact, including noise, is one of the main strategic goals both in the EU and in Lithuania [122]. Component of changes of noise pollution is also distinguished in empirical cases of cost benefit analysis, reflecting both Lithuanian and foreign [123] transport projects. The predicted growth of mobility and volumes of freight transported also reveals the importance of reduction of noise pollution. Component estimates may be also applied in estimating costs of noise pollution.
5. Reduction of air pollution	External environme	Reduction of air pollution is one of the main strategic goals both in the EU and in Lithuania [124]. This component of benefit is also distinguished in

[118] For example, reconstruction of the Trans-European network road E77 (Ryga-Šiauliai-Tauragė-Kaliningrad).

[119] For example, such goal has been set in the National Progress Programme (NPP) of 2014–2020.

[120] For example, Implementation of traffic safety and environmental means, stage I; Development of the Trans-European network roads E85 (Vilnius–Lyda) and E272 (Vilnius–Panevėžys–Šiauliai–Palanga): reconstruction of the section Šiauliai-Radviliškis of the road Panevėžys–Šiauliai (stage I).

[121]Pavyzdžiui, greitkelis A23 Ispanijoje (kurio atkarpos finansuotos iš 2000–2006 m. Sanglaudos fondo lėšų); detaliau žr. Ex Post Evaluation for Cohesion Fund (including former ISPA) 2000-2006 - Work Package B: Cost benefit analysis of selected transport projects.

[122]Fors example, such goal has been already set in the Strategy of Long-term Development of the Lithuanian Transport System (up to 2025).

[123]For example, the railway Thriassio–Kiato in Greece; for more details see Ex Post Evaluation for Cohesion Fund (including former ISPA) 2000-2006 - Work Package B: Cost benefit analysis of selected transport projects.

[124]For example, such goal has been set in the Strategy of Long-term Development of the Lithuanian Transport System (up to 2025).

Component	Types	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
	ntal impact	empirical cases of cost benefit analysis, reflecting both Lithuanian and foreign [125] transport projects. The predicted growth of mobility and volumes of freight transported also reveals the importance of reduction of air pollution. Component estimates may be also applied in estimating costs of air pollution (rising, for example, due to transport congestions during road reconstruction works).
6. Reduction of carbon dioxide (as greenhouse gas) emission	External environmental impact	Currently reduction of greenhouse gas emission is one of the most important strategic goals on the global level and it is also emphasized in the EU and Lithuanian strategic documents[126]. This component of benefit is also distinguished in empirical cases of cost benefit analysis, reflecting both Lithuanian and foreign [127] transport projects. Besides, the predicted growth of mobility and volumes of freight transported reveals the importance of reduction of greenhouse gas emission. Component estimates may be also applied in estimating the risk imposed by the increased greenhouse gas emission.

Attribution of benefit (damage) components to specific types of projects has been presented in Annex 1.

1.4.3. Calculation Methodology and Application Instructions

1. Time savings

Time savings are one of the most significant benefits which may occur due to construction of a new transport infrastructure or improvement of the existing one.

Calculation methodology and calculated estimate value

While carrying out a cost benefit analysis usually a divide between evaluation of work-related travel and non-work-related travel is made.

In order to establish value of the time devoted for work-related travels usually an attitude of "costs saving" is applied. The main assumption of such attitude is that costs suffered due to the time devoted by employees to work-related travels is covered by an employer who may use an employee for an alternative productive activity. Meanwhile the time devoted to non-work-related travels should be estimated by

[125]For example, the railway Thriassio–Kiato in Greece; for more details see Ex Post Evaluation for Cohesion Fund (including former ISPA) 2000-2006 - Work Package B: Cost benefit analysis of selected transport projects.
[126]For example, the need to reduce CO_2 emissions of road vehicles has been emphasized in the Strategy „Europe 2020".
[127]For example, Algarve railway in Portugal (the section from Coina (near Lisbon) to Faro, including the branch to Porto de Sines); for more details see Ex Post Evaluation for Cohesion Fund (including former ISPA) 2000-2006 - Work Package B: Cost benefit analysis of selected transport projects.

willingness of users to pay, revealing how people value their leisure time. In the international practice most often two ways are applied for evaluation of time savings:

- The first one – the time value is established based on ad hoc surveys that are useful because they reflect particularity of the project field, however, they are very expensive.
- The second one (used more often) – application of reference values obtained from researches performed on national or international level.

The main reference study is HEATCO[128], which delivers values applicable to separate EU states, besides, it delivers separately values applicable to freight and passenger transport users. The reviewed Lithuanian projects [129] have revealed that currently HEATCO values are used and invoked as the main reference point in almost all project assessments. Experience of foreign countries shows that HEATCO values remain the standard that is used most often. Nevertheless, as it has been noted in some studies[130], HEATCO double counts the time value in the countries where the average pay is well below the EU average. For instance, the time value calculated by HEATCO for Lithuania, applicable to passengers travelling even not on business, is much higher than the average pay in Lithuania. Therefore it is necessary to calculate the time value that would be more appropriate to Lithuania. The detailed description of methodology and the calculated time value are presented below.

In order to calculate the time value applicable to passengers who travel on business the table "M3061113: the average monthly costs and costs of one hour worked of an employee according to the classification of economic activities (CEA 2) and groups of enterprise size" published by the Lithuanian Department of Statistics may be used. The table comprises the average hourly pay in the national economy; in 2011 this value was 19.06 LTL. This value was revised using the conversion factor that equals to the simple average of the conversion factor of skilled workforce (0.973) and the conversion factor of unskilled workforce (0.888). The estimate received is 17.74 LTL.

However, this value may be considered as insufficiently assessing the real working time value. This is because people, who spend most on transport, usually earn most. It means that the working time value should be higher. In order to obtain at least an approximate size of the required correction reference may be made to the table "M3090208: the average consumption expenditure per one member of a household per month according to the classification of individual consumption by purpose (COICOP) and by groups of expenditure deciles" published by the Lithuanian Department of Statistics. In order obtain the value of the correction factor the following calculations should be made:

- The table presents data on consumption expenditure in cash and in kind for each decile (the latest available data – data of 2008). Based on the data of the table the average consumption expenditure per one member of a household were calculated (A);

[128]HEATCO study suggests the harmonised guidelines for assessment of international projects in Europe. It also comprises a uniform system intended for monetary evaluation, based on welfare economics principles and contributing to the consistency of establishment of transport costs over the long term. These guidelines have been developed while implementing the EC funded research HEATCO project based on the latest results of research on different transport project evaluation aspects and analysis of practice of the EU countries and Switzerland. See http://heatco.ier.uni-stuttgart.de/.

[129] For example: Reconstruction of the Trans-European network road E77 (Ryga-Šiauliai-Tauragė-Kaliningrad); the Trans-European network link – Vilnius western bypass, stage II.

[130] Guidance Manual for Cost Benefit Analysis (CBAs) Appraisal in Malta. - May 2013.

- The table presents data on transport expenditure per one member of a household for each group of expenditure decile; for consumption expenditure of each group of expenditure decile a weight was assigned having in mind transport expenditure of this decile group and thus the weighted average of consumption expenditure was calculated (B);
- (B) was divided by (A), estimate of 1.52 was received.

In order to estimate the final time value, the time value received earlier was multiplied by this correction factor. In 2011 the final working time estimate in Lithuania was 26.96 LTL per hour. Based on the rate of pay growth[131], this value was recalculated into the value of 2013. **Thus, estimating in prices of 2013, the time value applicable for a passenger travelling on business equals to 29.33 LTL / h.**

In order to calculate the time value for non-working passengers usual practice may be used and the working time value treated as two and a half time higher than the non-working time value[132].**Thus, estimating in prices of 2013, the time value applicable for a passenger travelling not on business equals to 11.73 LTL / h.**

Meanwhile in order to determine the time value for freight transport the HEATCO values remain the most appropriate reference point. Based on the nominal GDP growth rate the value calculated for Lithuania by HEATCO was recalculated into the value of 2013 (the initial values are presented in Annex 2 to the sector). **Measuring in prices of 2013, the suggested value for freight transport is 11.35 LTL per hour per one ton of freight carried.**

Comparison with other countries. Some analysed countries (for instance, Spain) use HEATCO values recalculating them into the values of the required year. As shown in Annex 2 to the sector, the unit values applicable to the countries analysed are higher and this fact may be explained mostly by differences in GDP per capita. Other countries use alternative values – for example, in Malta the time value for passengers is calculated based on the gross hourly pay[133]. For comparison the time value for passengers travelling on business in Malta in prices of 2011 was 52.03 LTL. Meanwhile the suggested value for Lithuania is 29.33 LTL. Such difference may be explained by differences of the hourly pay.

Application instructions

It should be noted that next to benefit provided by time savings it may be appropriate to evaluate a risk component related to time losses. Usually such risk occurs during project implementation, for example, during performance of road reconstruction works. The value of time losses is calculated in analogy to the case of calculation of the value of time savings, and the data required for calculations should be presented in a feasibility study.

In order to estimate benefit occurring due to travel time savings estimates of a benefit component should be applied to passengers (or tons in case of freight transport) and not to vehicles. If information available on traffic covers only the number of vehicles, this number should be converted into the number of passengers (or tons of freight) using the average number of people travelling by a vehicle (the average weight of freight carried). Values of the average number of passengers travelling by one vehicle and the

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[131]Forecast of the pay is presented by the Ministry of Finance of the Republic of Lithuania, see „Projections of Lithuanian Economic Indices“ (http://www.finmin.lt/web/finmin/aktualus_duomenys/makroekonomika).

[132] See, for example: Guidance Manual for Cost Benefit Analysis (CBAs) Appraisal in Malta. - May 2013.

[133] Guidance Manual for Cost Benefit Analysis (CBAs) Appraisal in Malta. - May 2013.

average weight of freight carried and provisions for demand prediction suggested for Lithuania have been provided in Annex 3 to the sector.

It is suggested to use the time value calculated without using the correction factor, reflecting the fact that people, who spend most on transport, usually earn most, to passengers travelling on business by public transport. I.e. the working time value of 19.30 LTL / h (in prices of 2013) is applicable. This value reflects, for instance, the working time value provided for in the section devoted to the social protection sector, applicable to the time saved by representatives of an employer (Component “1. Time Economy of a Job / Employee Search”).

In case of a specific project the forecast of transport flow, including distribution according to groups of travellers, should be provided by the project feasibility study. The project executor may use different values of the average number of passengers travelling by one vehicle and the average weight of freight carried from the indicated ones, however, such selection should be justified.

The simplified example is provided below.

Insert 8. Application of Estimate of Travel Time Savings

The project covers reconstruction of 10 km long road section with widening of road pavement.

Before the project implementation the annual average daily transport flow made 1000 vehicles per day. After the intervention increase in traffic flow is not expected, however, the improved road conditions allow driving faster than it was allowed on the non-reconstructed road thus creating travel time savings for the road users.

Assuming that the average vehicle speed before the reconstruction was 40 km / h, the time savings per one kilometre made:

- 29.33 / 40 = 0.73 LTL / km for passengers travelling on business;
- 11.73 / 40 = 0.29 LTL / km for passengers travelling not on business.

If after the road improvement a vehicle speed reaches 60 km / h, the time savings per one kilometre reduce to:

- 29.33 / 60=0.49 LTL / km for passengers travelling on business;
- 11.73 / 60 = 0.20 LTL / km for passengers travelling not on business.

Therefore the value of the travel time savings is:

- 0.73 – 0.49 = 0.24 LTL / km for passengers travelling on business;
- 0.29 – 0.20 = 0.09 LTL / km for passengers travelling not on business.

Considering the road length (10 km) the total value of the travel time savings conditioned by the project is 0.24 LTL / km* 10 km = 2.4 LTL per one passenger travelling on business and 0.09 / km* 10 km = 0.9 LTL per one passenger travelling not on business.

This value may be used for the estimated traffic flow that is 1000 vehicles per day. Considering the vehicle employment index to be equal to 1.2 passengers in one vehicle, traffic flow is 1200 passengers per day. Assuming that 50 % of travels are made for work purposes the annual project benefit related to travel time savings for road users is 2.4 LTL * 600 passengers per day* 365 days + 0.9 LTL * 600 passengers per day* 365 days = 722,700 LTL per year.

Source: Compiled by BGI Consulting and CSIL Milano.

Empirical case studies show that in some projects the current value of time savings makes the biggest part of the current overall value of the project benefit. Meanwhile in other projects this benefit may be insignificant. The example of two extreme cases is presented below.

Insert 9. Value of Time Savings – Example

The case of the highway A23 in Spain (the sections of which were financed from the Cohesion Fund of 2000–2006) shows the reconstruction of four sections of the highway A23. Ex post evaluation[134] revealed that the project benefit is obtained mostly from the time savings that are related to speed increase and reduction of traffic congestions on the new road (in comparison to the old one). The predicted speed increase in four analysed sections was from 63–90 km / h to 120 km / h for individual passenger cars and light commercial vehicles and from 51–73 km / h to 90–97 km / h for heavy goods vehicles.

Another example is the IX B transport corridor in Lithuania (for works of which co-financing from the Cohesion Fund of 2000–2006 was granted). Ex post evaluation[135] showed that time savings played only a minor role in this project. This is because the project contributed mostly to improvement of the road surface conditions (and reduction of vehicle operational costs). Meanwhile benefit of time savings was received only in the short section (due to construction of Vilnius southern bypass).

Source: Compiled by BGI Consulting and CSIL Milano.

Estimate update instructions

It is recommended to update values of benefit component estimates every one year.

First of all values applicable to the first year of analysis should be updated:

- The time value for freight should be updated by increasing the value of 2013 pro rata to the growth of nominal GDP per capita (based on the statistics published by the International Monetary Fund[136]);
- Values applicable to passengers should be recalculated based on the latest statistical data according to the above described formula.

Values of cost benefit analysis applicable to future years are calculated by increasing the values of the first year of cost benefit analysis pro rata to the growth of actual GDP per capita (based on the statistics published by the International Monetary Fund[137]).

2. Savings of Road Vehicle Operational Costs

Vehicle operational costs are monetary costs. It should be noted that monetary costs of transport also comprise rates and tolls.

[134] For more details see Ex Post Evaluation for Cohesion Fund (including former ISPA) 2000-2006 - Work Package B: Cost benefit analysis of selected transport projects.

[135] For more details see Ex Post Evaluation for Cohesion Fund (including former ISPA) 2000-2006 - Work Package B: Cost benefit analysis of selected transport projects.

[136] Source: http://www.imf.org/external/ns/cs.aspx?id=28.

[137] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The forecast of IMF does not cover the total period of economic analysis, therefore considering uncertainties occuring the annual growth rate for the remaining period is calculated as the average of annual GDP per capita growth rate during the last five years of the forecast.

Calculation methodology and calculated estimate value

Vehicle operational costs (VOC) are defined as costs that are suffered by a vehicle user while operating it. Savings due to reduction of vehicle operational costs is the typical impact of road transport projects. Other kinds of transport may also influence changes of vehicle operational costs[138]; however, such impact is most often insignificant.

HEATCO defines VOC as "consisting of vehicle fixed costs, that are independent of the distance driven, and operational costs, that change depending on the distance driven“. The same study recommends considering several components in calculating VOC (more detailed description is presented in Annex 4 to the sector).

Therefore there exit more than one model or computer programme intended for calculation of such VOC. These models require a large number of input data on, for example, composition of the vehicle fleet, characteristics of a road network, work standards. Such data influence the project impact related to VOC. Based on simulation results the project impact on VOC should be defined by a feasibility study.

If such data are unavailable a simplified procedure of VOC calculation in Lithuania is suggested as a possible solution. Specifically it is suggested to rely on the following structure of components when calculating VOC for Lithuanian road projects:

VOC = fuel costs + oil consumption + tyres depreciation costs + maintenance + tolls (if any)

It should be noted that personnel costs (wages of taxi, bus and heavy goods vehicle drivers) are usually already included into travel time savings to which monetary values are attributed based on common attitude that when less time is used for travel more time is left for alternative (or additional) productive activities. Therefore in order to avoid benefit double counting it is suggested not to include this component into VOC calculation.

Values of VOC calculated for light commercial vehicles and heavy goods vehicles applicable to Lithuania are presented in the table below. Values have been presented after deducting indirect charges.

Table 42. Vehicle Operational Costs in Lithuania (Lt / km in prices of 2013)

Vehicle type	VOC, LTL/km (with tolls)
Passenger cars	**0.5668**
Light commercial vehicles	**1.2661**
Heavy goods vehicles	**1.8354**

Source: Compiled by BGI Consulting and CSIL Milano according to the data provided by the Public Enterprise Road and Transport Research Institute. (Note: otherwise than in this table, data published the PE Road and Transport Research Institute are usually presented without deducting indirect charges)

[138]For example, a new railway one of the impact elements of which is reduction of congestions in an alternative road network. Road users of such road may benefit from vehicle operational costs savings.

Comparison with other countries. While calculating the VOC related project impact in the analysed countries (such as Italy, Spain, Germany) computer programmes are usually used. From numerous computer programmes HDM-4 programme seems to be used most widely. These programmes analyse the same cost elements that are suggested to be analysed for Lithuania. As VOC are highly dependent from fuel prices, differences among VOC values are conditioned by differences in fuel prices (it is necessary to have in mind that in economic analysis VOC value does not cover indirect charges). For example, VOC of passenger cars calculated for Poland (upgraded road pavement, speed – 90 km / h) in prices of 2008 is 1.111 PLN (or 1.14 Lt[139]) per one kilometre travelled by a vehicle and is well above the guide value suggested for Lithuania. However, such difference may be explained by the fact that the value applicable to Poland may include personnel costs and indirect charges unlike in the case of Lithuania.

Application instructions

In order to evaluate the net project benefit (or costs) vehicle operational costs should be calculated “before” the intervention (i.e. before project implementation) and “after” the intervention (i.e. after project implementation).

The VOC values presented above have been calculated based on “static” scenario (i.e. without a project), taking the year 2013 as a reference point. Therefore these values may be invoked as a reference situation (without a project) in the attitude of which any additional impact of a new project should be evaluated. Alternatively, if the state of the reconstructed road was extremely poor and VOC values were higher than reference values, reconstruction may reduce VOC to reference values (see the example presented in the Insert 10). Besides, the project may be beneficial not due to reduction of VOC per one kilometre, but due to change of kilometres driven by vehicles.

In practice it may be complicated to evaluate the net project impact on VOC without a computer programme. As it has been already mentioned the project VOC impact should be defined by a feasibility study based on simulation results. Therefore an analyst performing cost benefit analysis should simply take monetary values of the project impact from a feasibility study and insert them into the tables of economic analysis.

Nevertheless, in rare cases, when computer simulation results are unavailable, it is possible to predict a percentage deviation from the initial VOC based on the opinion of experts. The example is presented below:

[139] At the rate valid during calculations.

Insert 10. Example of Application of VOC Estimate

The road reconstruction project in the analysed road section reduces road pavement roughness (that is reflected by the international roughness index IRI) and increases the average speed from 70 km / h to 90 km / h. It is assumed that the project will not influence the number of vehicles travelling on this road section. With the help of the expert opinion (or computer simulation) it has been estimated that the current VOC per one kilometre driven on this road section (both for light commercial vehicles and heavy goods vehicles) are 20 % higher than the reference values. Based on the expert opinion prediction was made that due to reduction of fuel costs and maintenance costs after the project implementation VOC per one kilometre driven will decrease and be equal to the reference values. Then this difference is multiplied by the number of kilometres driven by vehicles in the specific year of cost benefit analysis period thus obtaining the value of VOC savings.

Source: Compiled by BGI Consulting and CSIL Milano

Estimate update instructions

It is recommended to update VOC values every one year. The VOC growth is likely to be close to inflation. It may be expected due to gradual vehicle fleet renewal and improved vehicle engines. Therefore VOC values are updated increasing values of 2013 pro rata to the growth of average consumer prices (based on statistics published by the International Monetary Fund[140]). Due to the same reason the same VOC values are applied during the whole period of cost benefit analysis.

3. Reduction of Accidents

All vehicles are naturally associated with the risk of road accidents. Due to mechanical faults or, which is often the case, due to influence of human faults vehicle-related accidents are relevant for all kinds of transport. Nevertheless comparison of different kinds of transport is difficult due to technological reasons.

Calculation methodology and calculated estimate value

According to HEATCO costs related to victims of accidents include:

- **Fatality:** death caused by an accident.
- **Severe injuries:** long-term injuries due to which the injured have to be treated in a hospital (however the latter do not die during the period of fatality recording).
- **Light injuries:** injuries due to which the injured do not have to be treated in a hospital or, if the injured are treated in a hospital, injury impact decreases rapidly.
- **Accidents that cause only material damage:** accidents without human injuries.

HEATCO presents values of economic costs intended for the specific countries that may be invoked in assessing accidents in the transport sector. Experience of foreign countries shows that HEATCO values remain the latest contribution into assessing safety in monetary terms based on willingness of individuals

[140] Source: http://www.imf.org/external/ns/cs.aspx?id=28 (index: Inflation, average consumer prices).

to pay for reduction of accident risk. Nevertheless, HEATCO double counts accident value in the countries where economic indices are well below the EU average. Therefore it suggested calculating an alternative estimate value for Lithuania.

Basis for such calculations is the value of statistical life (VSL)[141] which is described by economic literature as an amount which, in the attitude of society, would be appropriate to spend for saving life of an unnamed person[142]. VSL calculations are presented in the section intended for the health protection sector. **VSL for Lithuania calculated by the method of human capital is 990,047 LTL.**

In order to calculate costs of injuries HEATCO recommendations to apply 0.13 of VSL value reflecting fatality in case of severe injury and 0.01 – in case of light injury may be used.

VSL reflects losses of product created by a person who suffered an accident and it is the main but not the only element of accident costs. Next to this element direct and indirect economic costs are also distinguished which cover medical and rehabilitation, administrational (for example, rescue services, insurance), material losses costs.[143]. In order to determine the size of such costs the data used in the HEATCO study may be used showing that direct and indirect economic costs additionally make (in Euros in prices of 2002):

- 25,000 Euros in case of death;
- 5,000 Euros in case of severe injury;
- 200 Euros in case of light injury.

With regard to the average rate of Litas and Euro of 3.4605 that was fixed in 2002[144] and the nominal GDP per capita growth of 2.6513 (based on statistics published by the International Monetary Fund[145]), direct and indirect economic costs make:

- In case of death: 229,373 LTL in prices of 2013 or **0.2317** from losses of product created;
- In case of severe injury: 45,875 LTL in prices of 2013 or **0.3564** from losses of product created;
- In case of light injury: 1,835 LTL in prices of 2013 or **0.1853** from losses of product created.

Respectively accident values in prices of 2013 calculated for Lithuania are the following:

- **In case of fatality: 1,219,441 LTL,** calculated as VSL * (1 + 0.2317);
- **In case of severe injury: 174,577 LTL**, calculated as VSL * 0.13 * (1 + 0.3564);
- **In case of light injury: 11,735 LTL**, calculated as VSL * 0.01* (1 + 0.1853).

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[141] The term „Statistical life“ is used with regard to the fact that most safety measures are meant to reduce risk of death and not to avoid particular deaths. See Abelson P. (2010), The Value of Life and Health for Public Policy, Macquarie University, http://www.appliedeconomics.com.au/pubs/papers/pa03_health.htm.

[142] Žr. Björn Sund (2010), *Economic evaluation, value of life, stated preference methodology and determinants of risks*, Örebro Studies in Economics 21, Örebro University. OECD (2012), *Mortality Risk Valuation in Environment, Health and Transport Policies*, OECD Publishing. http://dx.doi.org/10.1787/9789264130807-en.

[143] For example, see HEATCO or EUROPEAN COMMISSION (1994): COST 313 Socio-economic costs of road accidents. Final report. Office for Official Publications of the European Communities, Luxembourg.

[144] Source: http://lb.lt/exchange/default.asp.

[145] Source: http://www.imf.org/external/ns/cs.aspx?id=28.

Comparison with other countries. Value of statistical life (VSL) is determined by income received by inhabitants, therefore VSL and values of accident costs respectively in the analysed countries (France, Germany, Italy, Spain and the United Kingdom) are significantly higher than the values applicable to Lithuania.

Application instructions

Though investments into transport infrastructure first of all are associated with the positive impact on reduction of accident number, however, in separate cases project implementation may mean increase in the number of accidents. For example, this may be the case when transport flows increase significantly due to project implementation. If the feasibility study confirms such risk component, value of accident costs is calculated in analogy to the case of calculations of benefit provided by accident reduction.

The first step of evaluation of benefit provided by accident reduction is to evaluate the number of accidents avoided in each case of the project alternative dividing accidents according to types.

Changes of number of fatalities, severe and light injuries, predicted due to project implementation, are usually presented in a feasibility study. Based on this information accidents should be considered from the economic perspective by assigning monetary value to them.

Empirical case studies reveal that economy part of accident losses in overall benefit depends on a specific project. For example, in projects intended exclusively for road safety measures this benefit may make up to 100 % of all benefit current value. Meanwhile, in other projects such savings may be insignificant or absent at all (for example, see Ex Post Evaluation of IX B transport corridor in Lithuania (for works of which additional financing was granted from the Cohesion Fund of 2000–2006[146]).

Estimate update instructions

It is recommended to update values of benefit component estimates every one year.

First of all values of benefit component estimates applied for the first year of cost benefit analysis period should be updated. Calculations are made based on the updated VSL value and presented the instructions for calculation.

Values applicable for the future years of cost benefit analysis period are calculated increasing the values of the first year of cost benefit analysis pro rata to the growth of actual GDP per capita (based on the forecast of the International Monetary Fund[147]).

[146]For more details see Ex Post Evaluation for Cohesion Fund (including former ISPA) 2000-2006 - Work Package B: Cost benefit analysis of selected transport projects.

[147] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The forecast of the IMF does not cover all period of economic analysis, therefore with regard to rising uncertainties, annual growth rate for the remaining period is calculated as the average of growth rate of annual GDP per capita during the last five years of the forecast.

4. Reduction of Noise Pollution

Noise pollution makes more influence on activity of consumers than on that of manufacturers and affects health. It is most relevant to road and air transport (during operation of infrastructure) as well as to railways located near to densely inhabited territories.

Calculation methodology and calculated estimate value

Noise pollution may be defined as an undesirable noise (in the sense of decibels) or sounds of different duration, intensity and other characteristics causing mental disorders to humans.

Noise costs are comprised from irritation costs and health costs:

- Irritation costs, especially related to vehicles, are social disturbances that determine such social and economic costs as restrictions of leisure enjoyment, discomfort or inconveniences etc.
- Health costs cover noise-related damage to physical health, for instance, higher than 50 dB(A) level of noise may cause serious hearing disorders or cardiovascular diseases.

There are several ways to attribute monetary value to noise impact of transport projects. The first one is to use the revealed preferences (real estate market prices). Literature describes impact of additional noise on (lower) prices of houses. According to the number of houses affected by project caused noise and the average price of a house it is possible to calculate total costs. Other methods (spoken out preferences) refer to irritation and health as well as willingness to accept compensation or willingness to pay for reduction of noise. Noise costs differ depending on time of day, density of population near the source of noise and the existing level of noise.

The HEATCO study presents values of costs suffered by one person for specific levels of noise based on researches of the preferences spoken out and qualitative evaluation of health impact. Experience of foreign countries shows that HEATCO values remain the most widely used reference point. Therefore it is suggested to invoke HEATCO values also in cost benefit analysis of Lithuanian projects.

Values applicable to Lithuania, recalculated into the values of 2013[148], are presented in the table below (separately for road, rail and air transport). Meanwhile, costs of noise due to maritime shipping and inland waterways transport are considered to be insignificant as costs per capita are comparatively low and majority of activities of these kinds of transport are executed further from densely inhabited territories.

Table 10. Costs of Separate Levels of Noise in Lithuania (in Litas per Capita in Prices of 2013)

dB(A)	Road Transport	Rail Transport	Air Transport
≥51	18.3	0.0	27.5
≥52	27.5	0.0	45.8
≥53	45.8	0.0	73.2
≥54	54.9	0.0	91.5
≥55	73.2	0.0	119.0
≥56	91.5	18.3	137.3

[148] Pro rata to the growth of nominal GDP per capita (based on the forecast of the International Monetary Fund).

dB(A)	Road Transport	Rail Transport	Air Transport
≥57	100.7	27.5	164.8
≥58	119.0	45.8	183.1
≥59	137.3	54.9	210.6
≥60	146.5	73.2	228.9
≥61	164.8	91.5	256.3
≥62	173.9	100.7	274.6
≥63	192.2	119.0	302.1
≥64	210.6	137.3	320.4
≥65	219.7	146.5	347.9
≥66	238.0	164.8	366.2
≥67	256.3	173.9	393.6
≥68	265.5	192.2	412.0
≥69	283.8	210.6	439.4
≥70	292.9	219.7	457.7
≥71	393.6	320.4	567.6
≥72	421.1	347.9	595.0
≥73	439.4	366.2	631.7
≥74	466.9	393.6	659.1
≥75	494.3	421.1	695.7
≥76	512.7	439.4	732.4
≥77	540.1	466.9	759.8
≥78	567.6	494.3	796.4
≥79	595.0	521.8	823.9
≥80	613.4	540.1	860.5
≥81	640.8	567.6	897.1

Source: Compiled by BGI Consulting and CSIL Milano according to HEATCO D5.

Values presented in the table are the annual values per person affected by noise pollution.

Comparison with other countries. Some analysed countries (for example Spain) also use HEATCO values recalculating them into the values of the required year. The unitary values for the analysed countries are higher and this is largely explained by differences in GDP per capita.

Application instructions

Investments into transport infrastructure may not only reduce but as well increase the level of noise. For example, upon construction of a high speed street noise will reduce in those streets from which transport will transfer into the new high speed street, but the increased noise impact will affect residents of the buildings located next to the new street. Therefore a feasibility study should evaluate also possible increase in noise pollution. The value of noise pollution risk is calculated in analogy to the case of calculations of value of benefit offered by decrease of noise pollution.

In order to evaluate noise costs data on the number of people who have suffered noise pollution and amount of noise (dB(A)) caused by / avoided due to the project are required. The example is given below:

Insert 11. Application of Limit Costs Estimates According to Levels of Noise

The road reconstruction project comprises installation of noise barriers and changing of windows in the houses which are affected by noise caused on road. Before the project 1000 inhabitants were affected by ≥55 dB(A) noise level. The project reduced noise level to 45 dB(A).

Annual costs avoided per one person are 73.2 LTL.

Total annual value of savings is:

73.2 LTL *1000 persons = 73,200 LTL.

Source: Compiled by BGI Consulting and CSIL Milano.

Empirical case studies show that part of noise pollution reduction in overall benefit depends on a specific project.

Estimate update instructions

It is recommended to update values of benefit component estimates every one year. Values of benefit component estimates applied for the first year of cost benefit analysis period are calculated increasing the values of 2013 pro rata to the growth of nominal GDP per capita (based on the forecast of the International Monetary Fund[149]). Values applicable to the future years of cost benefit analysis period are calculated increasing the values of the first year of cost benefit analysis pro rata to the growth of actual GDP per capita (based on the forecast of the International Monetary Fund[150]).

5. Reduction of Air Pollution

Some kinds of transport, especially electricity driven (railways, trams etc.), usually do not cause air pollution themselves, but it is done by their energy sources. Air pollution affects both activity of consumers and manufacturers, human health, material preservation, visibility and climate change.

[149] Source: http://www.imf.org/external/ns/cs.aspx?id=28.

[150] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The forecast of the IMF does not cover all period of economic analysis, therefore with regard to rising uncertainties, annual growth rate for the remaining period is calculated as the average of growth rate of annual GDP per capita during the last five years of the forecast.

Calculation methodology and calculated estimate value

It is known that investments into transport highly affect atmosphere pollution. In any cost benefit analysis that is used for evaluation of social costs of a project caused air pollution, estimate of such impact usually should cover the following cost elements: human health, material losses, harvest losses as well as losses that occurred due to damage caused to ecosystem.

List of pollutants should cover[151]:

- Transport emissions of particulates SP_{10} and, when possible, $SP_{2,5}$,
- Nitrogen oxides (NO_x) as nitrate aerosols and ozone precursors,
- Sulphurs dioxide (SO_2) as the source of direct impact and sulphate aerosols precursor,
- Non-methane volatile organic compounds (NMVOC) like ozone precursor.

The main reference studies, which may be referred to in search of impact estimates, are HEATCO/CAFE[152], which provide values for the EU Member States. Experience of foreign countries shows that these values remain the most widely used reference point. Therefore it is suggested to invoke HEATCO values also in cost benefit analysis of Lithuanian projects.

Table 44 summarises the unitary values of air pollution costs applicable to Lithuania recommended by HEATCO/CAFE (the table presents the values that are recalculated into the year of 2013). The values are based on calculations made by models that take into account population of each state, meteorological conditions and traffic structure (distribution of emissions). This attitude may be applied for all kinds of transport.

Table 11. Air Pollution Costs for all Kinds of Transport in Lithuania (Lt per One Ton of Emissions in Prices of 2013)

Pollutant	NO_x	NMVOC	SO_2	$SP_{2,5}$			SP_{10}		
				City	Town	Village	City	Town	Village
Lietuva	15.638	1.738	20.850	1.243.209	403.978	248.468	496.936	161.591	99.040

Source: Compiled by BGI Consulting and CSIL Milano according to the information provided in the document "Handbook on estimation of external costs in the transport sector"[153].

Note: For the purposes of application of estimates, a city is considered to be the town having more than 0.5 mln. of inhabitants.

[151]For example see HEATCO project (http://heatco.ier.uni-stuttgart.de/)

[152] CAFE, 2005. Mike Holland (EMRC), Steve Pye, Paul Watkiss (AEA Technology), Bert Droste-Franke, Peter Bickel (IER). Damages per tonne of PM2,5, NH3, SO2, NOx and VOC's of EU Member State (excluding Cyprus) and surrounding seas. Service Contract for carrying out cost-benefit analysis of air quality related issues, in particular in the clean air for Europe(CAFE) programme.

[153] Source: http://ec.europa.eu/transport/themes/sustainable/doc/2008_costs_handbook.pdf.

Comparison with other countries. The analysed countries (such as Italy, Spain) also use HEATCO/CAFE values recalculating them into the values of the required year. The unitary values for the analysed foreign countries are higher (except some of them). Differences in NO_x, NMVOC and SO_2 values among the countries are mostly determined by air composition (including ozone formation) and the number of inhabitants; differences observed in cases of particulates among the countries show the number of inhabitants affected which is mainly determined by the distance to the source of pollution and the prevailing wind direction.

Application methodology

Investments into transport infrastructure may have not only positive but also negative air pollution impact. Negative impact occurs usually during the project implementation, for example, when transport congestions increase during road reconstruction works. Therefore a feasibility study should also evaluate possible increase in air pollution. Value of air pollution increase risk is calculated in analogy to the case of calculations of value of benefit offered by decrease of noise pollution.

Information required when using the above suggested unitary values of air pollution costs is:

- **Transport flows:** Required data varies from traffic models related to specific route (-es) or corridor (-s) to summarised data for a certain geographic unit (country, region etc.). As well information on distribution of vehicles according to technology used is required.
- **Pollution emission:** In order to evaluate the annual amount of pollutant emission into atmosphere (in tons) pollution factors applicable for all vehicles (train, aircraft or ship) are required. These data depend on such factors as vehicle category, technology and traffic situations.

Project impact on amount of various pollutants discharged according to modelling results should be defined by a feasibility study. Usually impact on pollution amount is presented in a project environmental impact assessment report. These amounts should be multiplied by the unitary values thus obtaining the monetary value of impact.

Empirical case studies show that part of benefit of air pollution reduction in overall benefit depends on a specific project.

Estimate update instructions

It is recommended to update values of benefit component estimates every one year. Values of benefit component estimates applied for the first year of cost benefit analysis period calculations are calculated increasing the values of 2013 pro rata to the growth of GDP per capita expressed in standards of purchasing power. Values applicable to future years of cost benefit analysis are calculated by increasing values of the first year of cost benefit analysis pro rata to the growth of actual GDP per capita (based on the forecast of the International Monetary Fund[154]).

[154] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The forecast of the IMF does not cover all period of economic analysis, therefore with regard to rising uncertainties, annual growth rate for the remaining period is calculated as the average of growth rate of annual GDP per capita during the last five years of the forecast.

6. Reduction of carbon dioxide (as greenhouse gas) emission

Greenhouse gas (GHG) emissions by transport have a long-term impact of various nature and it is difficult to evaluate this impact.

Calculation methodology and calculated estimate value

Transport-conditioned impact of climate change and global warming occurs mostly due to greenhouse gas, specifically carbon dioxide (CO_2) emissions. GHG pollution has a global impact due to damage caused on the global scale; therefore there is no difference where GHG pollution, especially among the EU Member States, occurs.

The most developed countries evaluate greenhouse effect by assigning monetary values to CO_2 emission. According to this method the amount of CO_2 discharged into atmosphere (expressed in tons per year) is multiplied by its unitary costs presented in the table 45. The latter table presents the values indicated in the EC Guidelines 2008 that remain the most appropriate ones for such analysis.

Table 12. Recommended Economic Value of CO_2 Emission (in Litas per Ton of CO_2)

Year of Application	Economic value		
	Lower value	Central value	Upper value
2010–2019	28	86	169
2020–2029	59	138	242
2030–2039	76	190	345
2040–2049	76	242	466
≥2050	69	293	622

Source: Compiled by BGI Consulting and CSIL Milano according to the information provided for in the EC Guidelines 2008.

Based on the international practice and empirical case studies it is suggested to use central values for the whole 10-year period. For example, the value of 86 LTL per one ton of CO_2 should be used for every year of the period 2010–2019.

These values should not be updated as they already reflect the predicted increase in GHG impact value.

Comparison with other countries. All analysed countries (France, Germany, Italy, Spain and the United Kingdom) usually use the values provided for in the EC Guidelines 2008 or compatible ones. The unitary values for all analysed countries are the same, because there is no difference where, especially among the EU countries, GHG pollution takes place.

Application methodology

The methodology of cost benefit analysis chosen for Lithuania requires evaluation of external costs of GHG emissions.

Investments into transport infrastructure may have not only positive but also negative impact on the amount of carbon dioxide emission. Negative impact occurs usually during the project implementation, for example, when transport congestions increase during road reconstruction works. Therefore a feasibility study should also evaluate possible increase in CO_2 emission. The value of CO_2 emission increase risk is calculated in analogy to the case of calculations of value of benefit offered by decrease of CO_2 emission.

CO_2 amount is usually calculated based on pollution factors (per one unit of fuel used or one kilometre travelled) which depend on a specific project. Project impact on amount of various pollutants discharged according to the modelling results should be defined by a feasibility study. Usually impact on CO_2 amount is presented in a project environmental impact assessment report. This amount should be multiplied by the unitary value thus obtaining monetary value of impact.

Empirical case studies show that part of benefit of GHG pollution reduction in overall benefit depends on a specific project.

Estimate update instructions

These values should not be updated as they already reflect the predicted increase in GHG impact value.

1.4.4. Table of Estimates of Socio-Economic Impact of Transport Sector

To summarise, the established estimates of socio-economic impact are presented in Terms of Reference in the form of table given (Table 46). According to the requirements of Terms of Reference the table of indices has to be related to the conversion factors established by the service provider to ensure that there will be no benefit and risk double-counting in calculations.

Table 13. Estimates of Socio-Economic Impact Established for Transport Sector

Sector	Conversion Factors*	Quantitative assessment of the conversion factor *	Minimum workload	Quantitative Expression, LTL (in Prices of 2013)
Transport	N/a	N/a	1. Time savings	Time value (in prices of 2013): • For a passenger travelling on business: 29.33 LTL / h; • For a passenger travelling not on business: 11.73 LTL / h; • For freight transport: 11.35 LTL per hour for one ton of freight carried.
Transport	N/a	N/a	2. Road vehicle operational costs savings	Road vehicle operational costs applicable to scenario “without a project”: • 0.5668 LTL per kilometre for passenger cars • 1.2661 LTL per kilometre for light commercial vehicles • 1.8354 LTL per kilometre for heavy goods vehicles Based on the expert opinion a percentage deviation from initial VOC may be predicted (due to a project).
Transport	N/a	N/a	3. Reduction of accidents	Accident value: • 1,219,441 LTL for fatality; • 174,577 LTL for severe injury; • 11,735 LTL for light injury.

Sector	Conversion Factors*	Quantitative assessment of the conversion factor *	Minimum workload	Quantitative Expression, LTL (in Prices of 2013)
Transport	N/a	N/a	4. Reduction of noise pollution	Evaluation is based on changes of noise levels. Costs of separate levels of noise (in Litas per person affected by noise) are:

dB(A)	Road Transport	Rail Transport	Air Transport	Water Transport
≥51	18.3	0.0	27.5	Not applicable
≥52	27.5	0.0	45.8	
≥53	45.8	0.0	73.2	
≥54	54.9	0.0	91.5	
≥55	73.2	0.0	119.0	
≥56	91.5	18.3	137.3	
≥57	100.7	27.5	164.8	
≥58	119.0	45.8	183.1	
≥59	137.3	54.9	210.6	
≥60	146.5	73.2	228.9	
≥61	164.8	91.5	256.3	
≥62	173.9	100.7	274.6	
≥63	192.2	119.0	302.1	
≥64	210.6	137.3	320.4	
≥65	219.7	146.5	347.9	
≥66	238.0	164.8	366.2	
≥67	256.3	173.9	393.6	
≥68	265.5	192.2	412.0	
≥69	283.8	210.6	439.4	
≥70	292.9	219.7	457.7	
≥71	393.6	320.4	567.6	
≥72	421.1	347.9	595.0	
≥73	439.4	366.2	631.7	
≥74	466.9	393.6	659.1	
≥75	494.3	421.1	695.7	
≥76	512.7	439.4	732.4	
≥77	540.1	466.9	759.8	
≥78	567.6	494.3	796.4	
≥79	595.0	521.8	823.9	
≥80	613.4	540.1	860.5	
≥81	640.8	567.6	897.1	

<table>
<tr><th>Sector</th><th>Conversion Factors*</th><th>Quantitative assessment of the conversion factor *</th><th>Minimum workload</th><th>Quantitative Expression, LTL (in Prices of 2013)</th></tr>
<tr><td>Transport</td><td>N/a</td><td>N/a</td><td>5. Reduction of air pollution</td><td>in Litas per ton of pollutants discharged (for all kinds of transport):
<table>
<tr><th rowspan="2">Pollutant</th><th rowspan="2">NO_x</th><th rowspan="2">NMVOC</th><th rowspan="2">SO_2</th><th colspan="3">$SP_{2,5}$</th><th colspan="3">SP_{10}</th></tr>
<tr><th>City</th><th>Town</th><th>Village</th><th>City</th><th>Town</th><th>Village</th></tr>
<tr><td>Lithuania</td><td>15 638</td><td>1 738</td><td>20 850</td><td>1 243 209</td><td>403 978</td><td>248 468</td><td>496 936</td><td>161 591</td><td>99 040</td></tr>
</table>
Note: For the purposes of application of estimates, a city is considered to be the town having more than 0.5 mln. of inhabitants.</td></tr>
<tr><td>Transport</td><td>Energy</td><td>With the help of excise tax on fuel attempts are made to fix negative impact on climate change. However, the conversion factor applicable to energy eliminates all indirect charges, therefore application of estimate of greenhouse effect gas emission reduction does not create the risk of double-counting in calculations.</td><td>6. Reduction of carbon dioxide (as greenhouse gas) emission</td><td>In Litas per ton of CO_2:
<table>
<tr><th rowspan="2">Year of Application</th><th colspan="3">Economic Value</th></tr>
<tr><th>Lower Value</th><th>Central Value</th><th>Upper value</th></tr>
<tr><td>2010–2019</td><td>28</td><td>86</td><td>169</td></tr>
<tr><td>2020–2029</td><td>59</td><td>138</td><td>242</td></tr>
<tr><td>2030–2039</td><td>76</td><td>190</td><td>345</td></tr>
<tr><td>2040–2049</td><td>76</td><td>242</td><td>466</td></tr>
<tr><td>≥2050</td><td>69</td><td>293</td><td>622</td></tr>
</table></td></tr>
</table>

Notes:

* The table of indices should be related to the conversion factors established by the service provider to ensure that there will be no benefit and risk double-counting in calculations.

1.4.5. Annexes (Transport Sector)

Annex 1. Benefit (damage) Components Applicable to Different Types of Projects

Project type	Applicable Benefit (damage) Components
1. Development of rail transport	1. Time savings (or losses, for example, during reconstruction) 2. Road vehicle operational costs savings (if road users are encouraged to use railway) 3. Accident reduction 4. Reduction / increase in noise pollution 5. Reduction of air pollution 6. Reduction of carbon dioxide (as a greenhouse gas) emission
2. Development of road transport	1. Time savings (or losses, for example, during reconstruction) 2. Road vehicle operational costs savings 3. Reduction / increase in accidents 4. Reduction / increase in noise pollution 5. Reduction / increase in air pollution 6. Reduction / increase in carbon dioxide (as a greenhouse gas) emission
3. Development of water transport	1. Time savings (or losses, for example, during reconstruction) 2. Reduction / increase in air pollution 3. Reduction of carbon dioxide (as a greenhouse gas) emission
4. Development of air transport	1. Time savings (or losses, for example, during reconstruction) 2. Accident reduction 3. Reduction / increase in noise pollution 4. Reduction / increase in air pollution 5. Reduction / increase in carbon dioxide (as a greenhouse gas) emission
5. Public transport	1. Time savings 2. Road vehicle operational costs savings (if road users are encouraged to use public transport) 3. Reduction of air pollution 4. Reduction of carbon dioxide (as a greenhouse gas) emission

Source: Compiled by BGI Consulting and CSIL Milano.

Annex 2. HEATCO Tables Demonstrating Non-Market Impacts in Transport Projects

Table 1. Calculated Values of Accidents Avoided (in Euros in Prices of 2002)

State	Fatality	Severe Injury	Light Injury	Fatality	Severe Injury	Light Injury
	In Euros in Prices of Production Factors of 2002			*In Euros According to PPP in Prices of Production Factors of 2002*		
Prancūzija	1,617,000	225,800	17,000	1,548,000	216,300	16,200
Vokietija	1,661,000	229,400	18,600	1,493,000	206,500	16,700
Italija	1,430,000	183,700	14,100	1,493,000	191,900	14,700
Lietuva	**275,000**	**38,000**	**2,700**	**575,000**	**78,500**	**5,700**
Ispanija	1,122,000	138,900	10,500	1,302,000	161,800	12,200
Didžioji Britanija	1,815,000	235,100	18,600	1,617,000	208,900	16,600

Table 2. Calculated Values of Vehicle Time Savings for Passengers Travelling on Business (in Euros per Passenger per Hour) and Freight Transportation (in Euros per Ton of Freight Carried per Hour) in Prices of Production Factors of 2002

State	Passengers Travelling on Business (per Passenger per Hour)			Freight Transportation (per Ton of Freight Carried per Hour)	
	In Euros in Prices of Production Factors of 2002				
	Air Transport	Buses	Cars, trains	By Road	By Railway
Prancūzija	38.14	22.23	27.70	3.32	1.36
Vokietija	38.37	22.35	27.86	3.34	1.37
Italija	35.29	20.57	25.63	3.14	1.30
Lietuva	**15.95**	**9.29**	**11.58**	**1.76**	**0.72**
Ispanija	30.77	17.93	22.34	2.84	1.17
Didžioji Britanija	39.97	23.29	29.02	3.42	1.40

Table 3. Calculated Values of Vehicle Time Savings for Passengers Travelling not on Business (in Euros per Passenger per Hour) in Prices of Production Factors of 2002

Country	Short Distance Travels to/from Work			Long Distance Travels to/from Work			Other Short Distance Travels			Other Long Distance Travels		
	In Euros in Prices of Production Factors of 2002											
	By Air Transport	By Buses	By Cars, Trains	By Air Transport	By Buses	By Cars, Trains	By Air Transport	By Buses	By Cars, Trains	By Air Transport	By Buses	By Cars, Trains
Prancūzija	16.34	7.87	10.95	20.97	10.11	14.06	13.7	6.6	9.18	17.58	8.47	11.79
Vokietija	11.99	5.78	8.04	15.4	7.42	10.32	10.05	4.85	6.74	12.91	6.22	8.65
Italija	15.16	7.31	10.16	19.47	9.38	13.04	12.71	6.12	8.52	16.32	7.86	10.94
Lietuva	**6.62**	**3.19**	**4.43**	**8.49**	**4.09**	**5.69**	**5.55**	**2.67**	**3.72**	**7.12**	**3.43**	**4.77**
Ispanija	12.72	6.12	8.52	16.33	7.87	10.94	10.66	5.13	7.15	13.69	6.59	9.18
Didžioji Britanija	12.44	5.99	8.34	15.97	7.69	10.7	10.43	5.02	6.99	13.39	6.46	8.98

Annex 3. Demand Analysis

Traffic Research

In order to limit the research field of traffic intensity and economic impact related to it, a project impact field should be established. The impact field should be wide enough so that it could appropriately record internal mobility and the main impact conditioned by the project.

As well, with regard to the fact that demand may be at least partially met by different kinds of transport, complementarity of different kinds of transport should be given an appropriate evaluation.

Economic evaluation of transport projects first of all depends on overall project costs and costs and benefit attributed to users travelling in the analysed territory during traffic research. It helps to define the territory of research for design and economic purposes which should cover all roads where the project implementation influences significant changes in traffic flows. In order to manage large quantities of data required a computer traffic network model is invoked.

Accuracy of evaluation of future traffic flows will depend on available data and sources from a simple growth rate (see below) to more complicated calculations based on prediction of economic activity. Traffic flow and results of project economic activity are usually calculated for the whole project period.

Insert 1. Simplified Formula for Calculation of Growth of Traffic Intensity

When traffic intensity research is unavailable or it cannot be performed due to any reasons, with the help of socio-economic projections it is possible to evaluate roughly, based on the growth rate, demand of transport services. The following formula may be used:

$L = POP * GDP_{inh.} * E$

where:

L is likely annual transport growth rate;

POP is likely annual inhabitant number (population) growth rate in the analysed territory / region;

$GDP_{inh.}$ is likely annual regional GDP[155] per capita growth rate and

E is traffic elasticity rate in respect to GDP per capita growth.

Source: Compiled by BGI Consulting and CSIL Milano

Demand analysis usually depends on a specific project and should be based on such minimum information:

- Historical traffic flows both of passenger and freight transport;
- Predicted traffic flows for the alternative ”without a project“ for each time horizon year
- Predicted traffic flows for each project alternative for each time horizon year, except the existing, diverted and created traffic flows (see below).

[155] Forecasts of GDP and number of inhabitants in regions should be taken from the National Statistics Service (Lithuanian Department of Statistics) and EUROSTAT.

Information on traffic flows should be presented in such way that travel origin and destination could be seen (transit percentage, travel origin/destination and local/internal traffic), see the example below.

Insert 2. Example of Travel Origin-Destination Matrix

Travel origin-destination (O/D) matrix for each access to the transport network point *i* and each exit from the network point *j* presents traffic flow volume T_{ij} from *i* to *j* in a given time interval. Travel origin points (A, B...G) are marked in lines and destination points – in columns.

		Internal Destination Points				External Destination Points			
	O/D	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**SUM**
Internal Origin Points	**A**	T11	T12	T13	T14	T15	T16	T17	**P1**
	B	T21	T22	T23	T24	T25	T26	T27	**P2**
	C	T31	T32	T33	T34	T35	T36	T37	**P3**
	C	T41	T42	T43	T44	T45	T46	T47	**P4**
External Origin Points	**E**	T51	T52	T53	T54	T55	T56	T57	**P5**
	F	T61	T62	T63	T64	T65	T66	T67	**P6**
	G	T71	T72	T73	T74	T75	T76	T77	**P7**
	SUM	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	

Travel origin-destination matrix may be broken down into the following four traffic components:

- Internal traffic (yellow background)
- Transit traffic (pink background)
- Outgoing traffic (bluish background)
- Incoming traffic (green background)

Source: Compiled byBGI Consulting and CSIL Milano

Extent and level of such transport intensity particularity will depend on certain characteristics of each project (size, complexity, competition with other transport links etc.).

Demand Forecast

Traffic intensity forecasts should be compiled for the alternative “act as usual” and for all different project alternatives. In transport projects the following traffic components should be considered:

- **Usual (or existing) traffic** is traffic present in the existing network (in case of new projects) or traffic using the infrastructure that is planned to be renewed/reconstructed.
- **Diverted traffic** is traffic which is attracted from other roads or other kinds of transport due to the project implementation.
- **Created traffic** is additional flow occurring due to improvement of the transport infrastructure when better (for example, safer) transport conditions, including reduced overall transport costs, attract new users.

Classification provided above evaluates traffic according to “components” and it is valid for all types of transport projects. It should be noted that often different kinds of transport are interconnected[156].

Besides transport demand should be broken down according to the types of users. For all types of transport projects the following breakdown is valid:

- **Passenger transport traffic**
- **Freight transport traffic**

Passenger transport traffic may be further divided into smaller categories according to travel purpose, i.e.:

- **Business travels**
- **Non-business travels (to work / from work and leisure travels)**

Leisure travels and travels to work / from work are in turn divided into short distance and long distance travels.

The table presented below reviews the main traffic demand indices that are usually presented in transport feasibility studies.

Table 1. Traffic Demand Indices

	Index	Description
Traffic	Traffic flows per time unit: - Vehicles (number of vehicles per day, number of trains per year, number of aircrafts per day etc.) - Passengers (number of passengers per day / year) - Tons (tons per year)	This index is based on available survey data and use of specific time indices. Measurement of traffic flows is based on traffic flows per specific time unit (hour, day, and year).
	Vehicle kilometres	This index is determined multiplying the number of vehicles by the average travel distance measured in kilometres. This index is used for several kinds of transport, for example, train kilometres, bus kilometres etc.
Passengers	Passenger kilometres	This is the distance (in km) that passengers travel by transit vehicles, aircrafts, ships, trains, busses etc.;

[156] For example, installation of a new subway line may divert traffic from roads (cars, private and public transport).

	Index	Description
		the value of index is determined multiplying the number of passengers carried by the average distance of their travels.
Freight	Ton kilometres	This is the distance (in km) that freight travels in vehicles (lorries, aircrafts, ships, trains); the value of index is determined multiplying the number of freight tons carried by the average distance of their travel.

Source: Compiled by BGI Consulting and CSIL Milano

Besides, as shown below, road transport traffic has distinctive indices and parameters.

Insert 3. Indices of Road Transport Traffic

Two important indices are used in road projects – **Annual Average Daily Traffic Intensity** (AADTI) and **Vehicle Kilometres Travelled** (VKT). These indices play an essential role in carrying out traffic engineering analysis (for example, when calibrating a model, establishing traffic impact functions etc.) and making public policy decisions.

Average Daily Traffic Intensity (ADTI) varies depending on a day, a week, a month. Its evaluation covers calculation of traffic intensity by time periods selected at random. For planning and design purposes Annual Average Daily Traffic Intensity (AADTI) classified according to categories of vehicles is usually used. It is defined as overall annual traffic flows in both directions divided by 365. AADTI is the annual average of number of vehicles crossing a certain point in the established section (usually expressed in number of vehicles per day). It reflects transport flow on a certain road section (for example, in a railway link) during the average day of the year in the simplest way.

AADTI is considered to be one of the most important initial data sets. These are essential input data required for the development of a traffic model and exercises of calibration which may be used in planning construction of a new road, choosing road geometry, managing traffic congestions, designing road pavement etc. Annual traffic flows are obtained multiplying AADTI by 365.

Meanwhile, the most important index in predicting road transport is Vehicle Kilometres Travelled (VKT). This index is mandatory while calculating project cost and benefit. It is calculated multiplying the predicted number of vehicles on a certain road section by the distance travelled which usually is the same as the length of the road section.

the number of vehicles and VKT should always be divided according to types, preferably covering:

- In case of passenger transport traffic:
    - **Cars** (or passenger cars);
    - **Buses**;
- In case of freight transport traffic:

- **Light commercial vehicles** (< 3.5 t);
- **Heavy goods vehicles** (>3.5 t).

In case of passenger cars, for the sake of simplicity, a ”standard“ car is taken as a reference point. Usually the most widely used car is considered to be a reference of a standard car (for example, a car having a certain engine capacity). This information is required for the establishment of vehicle operational costs and project environmental impact.

It is also very important to collect information on the average number of people travelling by a vehicle (including a driver) and the weight of freight carried by a heavy goods vehicle (in tons). It helps to calculate the number of passengers and the freight volume to which travel time savings are applied.

In case of passenger transport the suggested average number of individuals travelling by cars and busses in Lithuania is[157]:

- **1.2 passengers in a car**
- **17 passengers in a bus**.

In case of freight transport the suggested weight of freight carried by light commercial vehicles and heavy goods vehicles in Lithuania is[158]:

- **12 tons in a heavy goods vehicle**
- **0.5 ton in a light commercial vehicle.**

Source: Compiled by BGI Consulting and CSIL Milano

Infrastructure Capacity

Transport indices are also useful for checking transport infrastructure capacity. Infrastructure of each type has its own technological characteristics, which are marked according to their function in the transport system, types of vehicles and operation. Transport infrastructure shares one common characteristics which not only defines such infrastructure but may be also used as a conceptual definition of capacity: maximum flow of vehicles (cars, aircrafts, trains or ships) per time unit or flow of final users (passengers or freight) at a certain level of quality and safety.

The largest infrastructure capacity may be defined two-fold:

- **Theoretic capacity** that is defined according to design / project of infrastructure (physical characteristics, dimensions, additional equipment etc.) and with regard to certain levels of quality and safety.
- **Operational capacity** that may sometimes exceed theoretic capacity (for example, in road transport) because sometimes it is possible to service larger traffic flows than it was planned at most, thus degrading quality conditions for users. In other cases, for example, railway, operational capacity for safety sake is lower than theoretic capacity.

[157] Based on the data provided by the PE Road and Transport Research Institute.

[158] Based on the data provided by the PE Road and Transport Research Institute.

It should also be noted that capacity of transport infrastructure varies depending on structure of traffic using it (for example, percentage of heavy goods vehicles on highways, variety of aircrafts in an airport, combination of train types and ship types in ports are highly important factors in measuring capacity).

The table below summarises main characteristics influencing capacity of main types of transport infrastructure.

Table 2. Transport Infrastructure Capacity

Capacity / Transport type	Main Characteristics	Unit of Measurement	Additional Factors Influencing Capacity
Airports	Number and length of runways. Large number of additional services.	Number of operations per hour. Number of passengers per day.	Presence of air traffic assistance system
Ports and multimodal infrastructure	Presence of a container terminal, type of additional services. Number of railway tracks.	TEU[159] number per day (for goods carried in containers) Tons per day (for bulk and other cargo)	Ship, crane characteristics
Railway	Line electrification. Presence of dual railway track.	Movement (of trains) per day	Signalling systems and number of tracks, stations
Roads	Number of lanes and width of road	Number of vehicles per hour	Gradient, percentage of heavy goods vehicle traffic

Source: Compiled by BGI Consulting and CSIL Milano

[159] Twenty-foot equivalent unit (TEU).

Annex 4. Calculation of Vehicle Operational Costs Applicable to Lithuania

Vehicle operational costs (VOC) are defined as costs which are incurred by a vehicle user operating it. Savings due to reduction of vehicle operational costs is a typical impact of road projects. HEATCO defines VOC as "comprised of vehicle fixed costs that are independent from distances driven, and operational costs, that vary depending on distance driven". The same study recommends considering the following components when calculating VOC:

- Components of fixed costs: amortisation (a time dependent part), interest on capital, repair and maintenance costs, material costs, insurance, overheads, administration;
- Components of variable costs: personnel costs (if not included into travel time savings), amortisation (a part depending on distance driven), fuel and oil, maintenance costs (related to distance driven). In the road transport sector vehicle operational costs usually cover costs of fuel, oil, spare parts, maintenance (working hours), tyres, amortisation and personnel travelling by a vehicle. Change of these costs is determined by a great number of various factors;
- Vehicle category – standard vehicle categories: passenger cars, light commercial vehicles, heavy goods vehicles and buses;
- Cruising speed in a respective road section (-s), which, in turn, depends on a great number of factors, including traffic;
- Condition of road pavement that is usually measured by the international roughness index (IRI);
- Other road characteristics (longitudinal gradient etc.)

VOC changes depending on type of vehicle, state of road pavement, road geometry and vehicle speed. These parameters in turn are related to characteristics of project territory (climate, culture etc.), suggested design standard (for example, asphalt, concrete or gravel surface), strategy of road maintenance, structure of traffic flows and level of traffic congestions.

There exists more than one model or computer programme intended for calculation of such VOC. From a great variety of computer programs that calculate VOC savings HDM-4 programme is nearly the most widely used. In calculations of VOC impact of investments into road infrastructure this programme alongside to other parameters models the dependence between vehicle operation and road depreciation that occurs over time. Therefore this model may be used to illustrate the need for additional investments.

HDM-4 requires a large number of input data on, for example, composition of vehicle fleet, characteristics of road network and work standards. Such data influence VOC related project impact.

Data on VOC project impact, based on HDM-4 results, should be presented in a feasibility study.

If such data are unavailable it is suggested to simplify the procedure intended for VOC calculation in Lithuania.

VOC calculation should include the following costs components:

- Personnel costs
- Fuel

- Oil and material (for example, tyres) costs
- Repair and maintenance costs
- Insurance, overheads, administration
- Tolls

Personnel costs (wages of taxi, bus and heavy goods vehicle drivers) are usually already included into travel time savings to which monetary values are attributed based on the common attitude that when less time is used for travel, more time is left for alternative (or additional) productive activities. Therefore, in order to avoid benefit double counting it is suggested not to include this component into VOC calculation.

Fuel consumption may be calculated according to fuel consumption parameters provided by car / lorry industry. In this case “average” or “standard” reference vehicles (light and heavy goods vehicles) must be defined (by measuring in horse power)[160].

In case of such costs components as oil and tyres sizes, operational costs are relatively general and values used in one state may be used for other states.

Data on insurance, overheads, administration costs should be collected on site with regard to specific vehicles in consultations with insurance companies and based on information on vehicles published by the journals / websites.

Finally, with regard to the fact that Lithuanian toll system is based on “vignettes”, toll costs may be considered to be fixed, calibrated according to traffic components and destination.

Alternatively, information on VOC values may be requested from national institutions making research in this field (in case of Lithuania – the PE Road and Transport Research Institute). The VOC values applicable for light and heavy goods vehicles for Lithuania are presented in the table below. The values have been presented after deduction of indirect charges.

Table 1. Vehicle Operational Costs in Lithuania (in Litas per Kilometre in Prices of 2013)

Transport type	VOC, LTL/km (with tolls)
Passenger cars	**0.5668**
Light commercial vehicles	**1.2661**
Heavy goods vehicles	**1.8354**

Source: Compiled by BGI Consulting and CSIL Milano according to the date provided by the Public Enterprise Road and Transport Research Institute. (Note: Otherwise as presented in this table, the PE Road and Transport Research Institute publishes data without deducting indirect charges)

[160] VOC of light commercial vehicles and buses may be considered to be the same as VOC of heavy goods vehicles.

1.5. Energetics

1.5.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.5.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The choice of benefit / damage elements was based on the approved list of general types of projects in the Lithuania's energy sector (provided in Table 47) and energy sector's research reports and guidelines: apart from the EC 2008 Guidelines, the EIB Guidelines[161] and other studies, contributing to identification and evaluation of effect of different energy projects were referred to.

The types of Lithuania's energy projects, financed lately and foreseen to be implemented during the programming period of 2014–2020 are mostly related with the natural gas, heating and electricity sectors. The energy projects, implemented in Lithuania, may be grouped into three broad categories:

- Development and modernization of energy transport, transmission and distribution networks (types 1, 2 and 3 in the table below),
- Power plants' construction and modernization (type 4),
- Improvement of buildings' energy characteristics (type 5).

Table 47. Types of general projects in the energy sector

Project type	Project examples
1. Integration of electrical energy and gas networks into the EU electrical energy and gas energy systems	1.1. Investments into the infrastructure, necessary for integration of energy networks into the EU electricity system 1.2. Investments into the infrastructure, necessary for integration of the gas networks into the EU gas energy system
2. Development of electricity, natural gas and heating transmission systems (and building of new systems) inside the country	2.1. Investments into development of electricity transmission systems 2.2. Investments into the natural gas transmission systems 2.3. Investments into development of heating transmission systems
3. Modernization of the electricity, natural gas and heating transmission	3.1. Investments into modernization of power transmission networks

[161] EIB – European Investment Bank (2013), "The Economic Appraisal of Investment projects at the EIB", Luxembourg.

Project type	Project examples
systems, existing within the country	3.2. Investments into modernization of natural gas transmission networks 3.3. Investments into modernization of heating transmission networks
4. Development of power plants, including those using renewable energy resources	4.1. Development of energy production capacities and increase in efficiency 4.2. Development of power plants, using renewable energy resources, producing heat and energy (modernization of the existing ones by changing the type of used fuel or construction of new power plants)
5. Reconstruction of public and apartment buildings in order to improve their energetic characteristics	5.1. Modernization of public buildings by improving their energetic characteristics 5.2. Reconstruction of apartment buildings by improving their energetic characteristics

Source: drawn by BGI Consulting and CSIL Milano according to the SFMIS, strategic planning documents and the information, provided by the Ministry of Economy of the Republic of Lithuania.

Depending on the specific type of implemented project, the energy sector's projects may result in different social benefit (distribution of the benefit / damage elements against specific types of projects is provided in Annex 1). The principal direct benefit, usually related with modernization of energy supply networks or power plants (types 1–4), is the following:

- Increase in reliability of electrical energy supply system;
- Increase in reliability of gas supply system;
- Reduction of energy costs due to replacement of the source of energy;
- Increase in energetic efficiency due to the reduction of energy loss, modernization of the existing power plants and encouragement of joint production of thermal and electrical energy (cogeneration).

The projects of type 5, i.e. reconstruction or modernization of buildings, are related with the benefits, resulting from the increase in energy use efficiency. An additional effect, i.e. increase in building users' convenience, is also possible.

Any energy projects characterize with two types of external effect on the environment, i.e. the emission of greenhouse gases (carbon dioxide and methane) and pollution changes.

Energy projects can also be related with reduction of risks, raised by accidents to human life, which should also be considered when performing the economic analysis.

The detailed substantiation of choice of the benefits / damage elements is provided in Table 48.

Table 48. Arguments for selection the benefit / damage elements

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Increase in reliability of the electrical energy supply system	Direct effect	Among the benefits, provided by energy projects in Lithuania is avoidance of technical faults in supply of energy, emerging due to difficulties when ensuring reliable supply of energy in certain locations or at certain times of the day or seasons of the year, which is especially relevant for the projects, foreseeing construction or modernization of electricity transmission or distribution systems. In the EIB CBA Guidelines 2013[162] the increase in reliability of the electrical energy supply system is also highlighted as a possible benefit of energy projects.
2. Increase in gas supply reliability	Direct effect	Diversification of the sources of import of natural gas, which are, at present, imported only from Russia, would allow for increasing the gas supply security. That is one of the principal strategic goals of Lithuania's and EU energy sector. The increased security of gas supply is also highlighted as a possible benefit of energy projects in the EIB CBA Guidelines and in the JASPERS Staff Working Paper[163].
3. Reduction of energy costs due to replacement of the energy source	Direct effect	This benefit element shall be applied in regard to the projects, for implementation of which, the primary energy source of fuel, used previously, is replaced by another fuel or source or the market, supplying energy of the same type is changed, while the energy demand remains the same as if the project is not implemented. In all the said cases the rating of the benefit element is based by the alternative costs for fuel and energy sources, which should be taken into consideration when calculating the changes of energy production or import costs in the economic analysis, comparing the above with the situation if the project is not implemented. The benefit element does not cover the changes of external costs (for instance, emission of gases, resulting in greenhouse effect and pollution) or the increase in reliability of electrical energy and gas supply, for which other benefit elements are attributed. Energy costs savings, resulting from change of the source of energy are highlighted as a potential benefit of energy projects in the EC Guidelines 2008, the JASPERS Staff Working Paper 2011, the EIB CBA Guidelines 2013 and in the empirical CBA of Lithuania's[164] and foreign countries' energy projects.

[162]EIB – European Investment Bank (2013), "The Economic Appraisal of Investment projects at the EIB", Luxembourg.
[163]JASPERS (2011),"Economic Analysis of Gas Pipeline Projects", by Francesco Angelini, Staff Working Paper, JASPERS Knowledge Economy, Energy and Waste Division.
[164] For instance, construction of the gas transmission pipeline Jurbarkas–Klaipėda.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		This benefit element may be used for different investment projects, such as: – New energy links with foreign countries in order to diversify markets, from which the electricity is imported and replace the import from relatively more expensive sources by import from relatively less expensive sources; – The energy producing power plants, used for substantiation of import of the same energy product: in this case the benefit element allows for the benefit due to the reduction of dependence on the energy import. That is one of the essential goals of Lithuania's and EU energy sectors, stated in the EC Guidelines 2008; – Power plants, producing electrical energy by using other fuel or source (for instance, renewable energy sources, replacing fossil fuel), compared with the situation in case the project is not implemented: the element will reflect the effect of transition from one energy source to another (not taking into consideration the external costs, such as emission of gases, resulting in greenhouse effect and pollution changes).
4. Improvement of buildings' energy characteristics	Direct effect	This benefit element is used for evaluating the interventions, aimed at improving the buildings' energetic characteristics. The element provides two benefits: – Reduction of the energy consumption costs, which is stated as one of the principal goals of Lithuania's energy sector; – Increase in comfort due to better insulation and higher temperature inside the buildings. This benefit is mentioned in the studies, analyzing the effect of buildings' energetic reconstruction[165] and in the EIB CBA Guidelines 2013.
5. Reduction of emission of carbon dioxide (as a greenhouse gas)	External effect on the environment	Reduction of emission of greenhouse gases is a goal, set for the energy and most other areas (transport, environment protection, industry, etc.) both in the EU and on the global level. It is related with the principle of sustainable economic development[166], which is most frequently referred to when fighting the climate changes and

[165] For instance, Clinch J.P. and Healy J.D. (2001) "Cost-benefit analysis of domestic energy efficiency", Energy Policy 29: 113-124.

[166] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Mainstreaming sustainable development into EU policies: 2009 Review of the European Union Strategy for Sustainable Development, COM/2009/0400 final.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
6. Reduction of emission of methane (as a greenhouse gas)		encouraging an economy, emitting the minimum amount of carbon dioxide into the environment. This effect is usually evaluated in the empirical CBA of Lithuanian and foreign countries' energy projects and is highlighted in the EC Guidelines 2008 and in the EIB CBA Guidelines 2013. The reduction of emission of greenhouse gases is attributed to the external costs, characteristic of the projects, aimed at replacing the fuel, emitting more greenhouse gases by "greener" fuel (for instance, renewable energy sources).
7. Air pollution changes	External effect on the environment	When implementing any energy project a certain amount of air polluting compounds is emitted, such as SO_2, NO_x and hard particles. The difference between the emission before and after implementing the project may reflect social cost or social benefit. This effect is usually evaluated in Lithuanian and foreign countries' energy projects' empirical CBA and is mentioned in the EC Guidelines 2008 and in the EIB CBA Guidelines 2013.
8. Reduction of accidents	External effect	That is an external economic benefit, emerging due to the reduction of injuries or deaths, experienced when implementing dangerous projects, such as projects, dealing with transmission and distribution of gas, relating with possibility of explosions or fire. This benefit is mentioned in the EC Guidelines 2008 and in the sector literature[167]. Even if the reduction of accidents is not one of the principal strategic goals in Lithuania's energy sector, in case of certain projects it may reflect actual external costs.

Source: BGI Consulting and CSIL Milano.

1.5.3. Calculation Methodology and Application Instructions

1. Increase in reliability of the electrical energy supply system

Some projects may result in increase in reliability of supply of electrical energy, which manifests in reduction of electrical energy supply interruptions during a certain time of the day, season or in a certain geographic location. This benefit should be taken into consideration when analyzing the projects, foreseeing construction and modernization of electrical energy transmission stations or connectors in order to increase the reliability of supply of electrical energy.

[167] For instance, IER – Institute for Energy Economics and the Rational Use of Energy (2004), "New Elements for the Assessment of External Costs from Energy Technologies", Final Report to the European Commission, DG Research, Technological Development and Demonstration; Burgherr P. and Hirschberg S. (2005), "Comprehensive Assessment of Energy System (GaBE) – Comparative Assessment of Natural Gas Accident Risks", Paul Scherrer Institut (PSI) n. 05-01, January 2005.

Calculation methodology and calculated estimate value

The theory references describe different methodologies, intended for evaluating the benefit of increasing of reliability of supply of electric power, which are also implemented in practice by the CBA. A more detailed overview of such methodologies is provided in Annex 3. The most frequently applied methodology involves the identification of the consumer's willingness to pay for the avoided electrical energy supply interruptions by using the method of stated preferences. Since such ratings have never been calculated in Lithuania, another method is suggested.

For calculation of the benefit, provided by the increase in reliability of supply of electrical energy in Lithuania the method of avoided costs is suggested to be used, i.e. to refer to the economic cost of non-supplied electrical energy, avoided as the result of the increase in reliability of the electrical energy supply system. The costs are calculated by dividing the annual gross value added (GVA) of each sector of economy[168] by the amount of electrical energy, sold and consumed in the same sector.

The costs of electrical energy, non-provided to household consumers are identified in a similar manner, i.e. by dividing the annual household income by the annual consumption of electrical energy in households. That is a very simple and useful method, since it is not based by direct surveys in order to identify the consumers' willingness to pay. It was used in the research, performed by Lehtonen and Lemstrom[169] and for evaluating the costs of electrical energy supply interruptions in Estonia[170]. This method also corresponds to the approach, usually referred to when evaluating the similar benefit, i.e. increase in reliability of supply of gas (for more detail, refer to the gas supply reliability increase element).

After applying the said methodology to Lithuania's economy, the results, shown in Table 49, were obtained. The values should be used as the rating of the value of increase in reliability of supply of electrical energy, applicable to Lithuania. The cost of one unit of non-supplied electrical energy was calculated for four sectors of economy, i.e. industry (including construction), commercial/transportation/public services, agriculture/forestry/fishery and for the residential sector. For data on the said sectors' GVA, received revenues and consumption of electrical energy are provided by Statistics Lithuania[171].

Table 49. Electrical energy interruptions' costs in Lithuania according to the prices of 2013 (LTL/kWh)

Sector	Cost of non-supplied electrical energy (LTL/kWh)	Cost of non-supplied electrical energy (ct/Kcal)
Industrial, including construction	11.71	1.362
Commercial, transportation and public	22.13	2.574

[168] Without adding the taxes for products and without subtracting the subsidies for products

[169] Lehtonen, M., and Lemstrom, B. (1995), "Comparison of the Methods for Assessing the Customers' Outage Costs," Proceedings of Energy Management and Power Delivery, 1, 1-6

[170] Raesaar, P., Tiigimagi, E., Valtin, J. (2005) "Assessment of electricity supply interruption costs in Estonian Power System", Oil Shale Pub. Nevertheless the GDP indicator was in the research instead of GVA

[171] Tables "M2010252: Gross value added and gross national product through the method of production. Features: type of economic activity (EVRK 2; 10 activities)", "M8020308: Energy balance, thous. tons in oil equivalent. Features: type of fuel and energy, year", "M3080101: Average received income per month. Features: location of residence, Statistics Lithuania Annual (per number of households)".

Sector	Cost of non-supplied electrical energy (LTL/kWh)	Cost of non-supplied electrical energy (ct/Kcal)
services		
Agriculture, forestry and fishery	23.87	2.776
Residential	17.23	1.869
Entire country	12.23	1.423

Source: BGI Consulting and CSIL Milano

Comparison with other countries. It is difficult to compare the ratings of willingness to pay for the increase in reliability of supply of electrical energy due to different ways of evaluation, local market conditions, intensity of consumption of electrical energy and other specific national characteristics. Due to this reason the benefit element's ratings for Lithuania were not calculating by the benefit transfer method (which is described in detail in Annex 3). The suggested methodology for calculating the cost of non-provided electrical energy is not new – it was used, for instance, in 2003, when calculating the values for Estonia. The results, obtained for Lithuania may not be directly compared with those of Estonia, since the latter were calculated in 2003 and they are not likely to remain relevant today. Instead, Estonia's values were recalculated in accordance with the method, used for Lithuania and referring to newer data (as of 2010). The results showed that the costs of non-provided electrical energy in Estonia are smaller than those calculated for Lithuania in all the sectors of economy with the exception of the commercial/transportation/public services sector, where Estonia's cost was higher.

Application instructions

In order to apply the calculated values of benefit element's rating, provided above, the following data are needed:

- The overall increase in the amount of supplied electrical energy as the result of the implemented project, compared to the situation in case the project is not implemented, in which case interruptions would be more frequent or would take longer time to eliminate - the duration (usually from several minutes to several hours) and possibility of technical electrical energy supply interruptions may be evaluated according to the historical data;
- The types of consumers, receiving benefit due to increase in reliability of supply of electrical energy, divided according to sectors, such as residential, industrial, commercial/transportation/public services and agriculture/forestry/fishery;
- The annual increase in electrical energy, supplied to each sector, calculated by multiplying the total amount of electrical energy by the share of end use, supplied for the specific sector;
- The annual benefit for each sector, obtained by multiplying the avoided cost due to non-supplied energy (provided in Table 49) by the increase in consumed amount of energy. In that case the overall annual benefit is calculated by adding up the costs, avoided in all the sectors.

It should be noted that the ratings of increase in reliability of supply of electrical energy should be used for calculating only the value of the additional amount of electrical energy, supplied as the result of reduction of electrical energy supply interruptions but not the value of the overall amount of electricity, sold to the end users.

A simplified example of application of the benefit element's rating is provided below.

Insert 122. Application of the rating of increase in reliability of the electrical energy supply system

For instance, in order to calculate the avoided cost of non-provided electrical energy, the project is analyzed, which is aimed at constructing a new 330 kV transformer substation, intended for increasing the reliability of the electrical energy transmission system and avoiding electrical energy supply interruptions. Before implementing the project the electrical energy supply interruptions were frequent and it was calculated that on the territory, affected by the project the reliability of supply of electrical energy shall increase by 5 % as the result of implementation of the project, which means additional 100.000 kWh of electrical energy, provided to the customers each year.

The structure of beneficiaries of the project is the following:

- Households – 30 %;
- Industrial sector – 30 %;
- Commercial sector – 35 %;
- Agricultural, forestry and fishery sector – 5 %.

The annual benefit can be estimated, first and foremost, by calculating the increase in the amount of electrical energy (expressed in kWh) for each type of consumers and then by multiplying the amounts of electrical energy by piece costs, provided in Table **Error! Reference source not found.**. The overall annual non-discounted benefit of the increase in reliability of supply of electrical energy, in this example, is approximately LTL 1.76 million (according to the prices as of 2013).

Sector	Electrical energy market share (%)	Increase in the amount of supplied electrical energy (kWh per year)	Annual avoided cost (LTL)
Industrial, including construction	30	30,000	351,300
Commercial, transportation and services	35	35,000	774,550
Agricultural, forestry and fishery	5	5,000	119,350
Residential	30	30,000	516,900
Total	100	100,000	1,762,100

Source: BGI Consulting and CSIL Milano

Estimate update instructions

The provided piece costs of non-supplied electrical energy should be used till a comprehensive analysis of Lithuania's electrical energy consumers is performed and the willingness to pay for increase in reliability of supply of electrical energy is identified.

Until such data is available, the provided piece costs may be recalculated referring to the updated values of the GVA, household income and electrical energy consumption levels. It is recommended to perform such updates each year. The values, applicable to the future years of the time period of the CBA, are calculated by increasing the value of the first year of the CBA in proportion to the increase in the actual GDP per capita (referring to the forecasts of the International Monetary Fund[172]).

2. Increasing the gas supply reliability

More than one investment project is planned to be implemented in Lithuania's gas sector. The principal aim of the projects is diversification of the sources of import of gas, which is at presently imported only from Russia. The construction of a liquefied natural gas terminal and gas pipelines, connecting Lithuania and Poland, will allow for increasing the security of supply of gas in the country. Contrary to the reliability of supply of electrical energy, mostly depending on the technical factors and relating with short-time (up to several hours) electrical energy supply interruptions, the gas supply security depends on political actions beyond control by the national players, which can result in prolonged interruptions up to several days.

Calculation methodology and calculated estimate value

Increase in reliability of gas supply can be viewed upon as avoidance of economic costs, which would otherwise emerge in case of gas supply interruptions. This approach corresponds to the methodology, applicable to evaluation of increase in reliability of supply of electrical energy and includes calculation of the GVA for one consumed unit of gas[173] in different sectors of Lithuania's economy and the income of households for one consumed unit of gas. In other words, the benefit is calculated as the social and economic damage, avoided as the result of implementation of the project. This methodology, referred to, for instance, in the JASPERS Staff Working Paper[174], is recommended in Lithuania's case, since other ratings of consumers' willingness to pay for the reliability of supply of gas (for instance, established by evaluating the contingent) are unavailable.

Application of this methodology would result in relatively higher cost due to non-provided gas (LTL 588.98 per m^3) in the commercial, transport and public services sector. If there are reasons to believe that such value is higher than the cost of gas supply interruptions in the sector, the project evaluator should, as an alternative, use the benefit element's rating value, calculated not for the sector, but for the whole country.

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[172] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The forecast of the IMF does not cover the entire time period the economic analysis, therefore, taking the ambiguities into consideration, the annual growth rate for the remaining period is calculated as the average of growth rate of the GDP per capita during the last five years.

[173] Net of taxes and subsidies.

[174] JASPERS (2011),"Economic Analysis of Gas Pipeline Projects", by Francesco Angelini, Staff Working Paper, JASPERS Knowledge Economy, Energy and Waste Division.

Table 50. Gas supply interruption costs in Lithuania according to the prices of 2013

Sector	Non-provided gas cost (LTL/m^3)	Non-provided gas cost (ct/Kcal)
Industrial, including construction	97.08	1.177
Commercial, transportation and services	619.57	7.510
Agriculture, forestry and fishery	130.33	1.580
Residential	258.52	2.923
Entire country	165.43	2.005

Source: BGI Consulting and CSIL Milano

Comparison with other countries. In the Oxera study[175] the gas supply interruption costs to the consumers in the UK's industrial sector were calculated as the GVA, not created as the result of the interruptions. It was established that economic costs vary from approximately LTL 69 / m^3 in case of short interruptions to LTL 425 / m^3 in case of prolonged interruptions (the ratings of 2007, recalculated to the values as of 2013). The values are coordinated with the values, calculated for Lithuania, i.e. the difference can be explained by economic and structural factors. The ratings, established by evaluating the contingent, result in lower values. Chou et al[176] (2011) performed a survey with the aim of identifying the gas consumers' willingness in France, the UK and Italy to pay for improvement of gas supply. The chosen experimental model revealed that the willingness to pay in the UK during the cold season is LTL 30 / m^3. This rating is even lower in France, where it fluctuates from LTL 10 to 13 / m^3. In Italy, where the dependency on gas is especially large, the willingness to pay during the cold season varies from LTL 50 to 161 / m^3, while during the warmer season it is LTL 78 / m^3 (the ratings of 2008, recalculated to the values as of 2013).

Application instructions

The value of increase in gas supply reliability is applicable only to the additional amount of gas, supplied as the result of implementation of the project, compared to the situation where the project is not implemented, where, in case of gas supply interruptions, the number and duration of interruptions would be significantly larger. Since the security of gas supply mostly depends on external, rather than technical factors (as in case of reliability of supply of electrical energy), it is very difficult to evaluate the overall annual increase in the amount of supplied gas as the result of implementation of the project, since the counterfactual situation is very vague. The probability and duration of gas supply interruptions can be established according to the historical data of experienced interruptions. Taking into consideration the vagueness of the said variables, they should always be verified by way of sensitivity and risk analysis.

In case the rating of increase in supplied gas as the result of implementation of the project and the structure of consumers, receiving benefit due to the increase in reliability of gas supply against the sectors of economy are known, the benefit is calculated in the same procedure as in case of increase in reliability of the electrical energy supply system, i.e. by multiplying the avoided non-provided gas costs (shown in Table

[175]Oxera (2007), "An assessment of the potential measures to improve gas security of supply", http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file38980.

[176]Chou W-J., Bigano A., Hunt A., La Branche S., Markandya A. and Pierfederici R. (2011) "Households' WTP for the Reliability of Gas Supply", BC3 Working Paper Series 2011-05.

50) by the increase in the amount of consumed gas. The total annual benefit is obtained by adding up the costs, avoided in different sectors of economy.

There is also an alternative methodology for calculating the value of increase in gas supply reliability. The costs of the alternative source of energy, used for counterbalancing the interrupted supply of gas and ensuring the same amount of energy, avoided as the result of implementation of the project, are calculated. Depending on consumption of gas in each sector of economy and on the specific evaluated project, different alternative sources may be evaluated. As an alternative to gas for the heating and food cooking purposes, electrical energy can be used. The cost of electrical energy, calculated referring to the piece costs, shown in Table 49 together with additional expenses for ensuring the same amount of consumer energy (for instance, for purchasing electric stoves or boilers, in case the assumption is made that the consumers do not have such equipment), reflects the willingness to pay for the increase in reliability of supply of gas.

Estimate update instructions

The provided piece costs of non-supplied gas should be used till a comprehensive analysis of Lithuania's gas consumers is performed and the willingness to pay for increase in reliability of supply of gas is identified. Until such data is available, the provided piece costs may be recalculated referring to the updated values of the GVA, household income and gas consumption levels. It is recommended to perform such updates each year. The values, applicable to the future years of the time period of the CBA, are calculated by increasing the value of the first year of the CBA in proportion to the increase in the actual GDP per capita (referring to the forecasts of the International Monetary Fund[177]).

3. Reduction of energy costs as the result of replacement of the source of energy

Lithuania's National Energy Strategy foresees an advanced replacement of certain sources of energy, which will help to reach different goals:

- In the area of natural gas Lithuania has the goal to reduce the import dependence on Russia therefore it reaches for changing the source of import by commencing importing from Poland and other countries;
- In the area of electrical energy more varied goals are raised:
    - At present Lithuania is very dependent on the import of electrical energy. One of the goals of the National Energy Strategy is to develop energy links with other countries and increase the diversification of sources of energy, by replacing the import from relatively more expensive sources by import from relatively cheaper sources. For instance, after launching the energy link with Sweden Lithuania will gain access to cheaper electrical energy (mostly produced at hydroelectric power stations and obtained from nuclear sources) than that, which is imported through Latvia at present.

[177] Source: http://www.imf.org/external/ns/cs.aspx?id=28. The forecast of the IMF does not cover the entire time period the economic analysis, therefore, taking the ambiguities into consideration, the annual growth rate for the remaining period is calculated as the average of growth rate of the GDP per capita during the last five years.

- In order to reduce the dependence on the import of electrical energy Lithuania plans to replace a certain share of imported electrical energy by that, produced by using biomass, natural gas or renewable sources of energy.
- There is an opinion that the national and the EU target to increase the use of renewable sources of energy is likely to result in replacement of fossil energy sources, used for production of electrical energy, by more environment friendly sources, such as water-power.

This chapter presents evaluation of benefits of energy source replacement in all cases, listed above.

Calculation methodology and calculated estimate value

The benefits, obtained by replacing a source of energy by another, apart from external costs (reflected by further elements of the effect), are also reflected by the difference of alternative costs of production and transportation of energy. In order to identify the alternative costs of the replaced and the replacement sources, long run marginal costs (LRMC) must be referred to.

As regards natural gas Lithuania reaches to replace the gas, presently imported only from Russia, by cheaper gas, which will be imported via Poland. Nevertheless, in the case of the provided example, the gas import source replacement is not related with the production cost differences, since in both cases the natural gas is extracted in Russia at similar production cost. The difference is determined by the lower price of gas, imported via Poland, compared with the price of gas, directly sold by Russia to Lithuania, which is higher due to political reasons. In case the planned infrastructure allows for replacing the gas, imported from Russia, by gas, extracted in another country, that will result in different long run marginal costs. Although the import price and price to the consumers is already forecasted, it still can be very difficult to identify the replacement gas production costs. Therefore it is suggested to evaluate the benefit of such investment referring to the increase in the consumers' surplus due to the gas prices' reduction. This benefit may be calculated by applying the ½ rule, i.e. taking into consideration the reduction of gas prices to the end user and the increase in consumption, which can be expressed in two ways, i.e. as the increase in the number of consumers (certain individuals, who do not use gas before the project, start doing that after the project is implemented) or as the increase in the consumed amount of gas (for instance, when, as the result of the project people start using more gas for heating, since the gas is cheaper). Referring to the ½ rule, the surplus of consumers is calculated according to the following formula:

$$\Delta VP = \frac{1}{2} * (K_0 - K_1) * (S_0 + S_1)$$

where ΔVP is the change of the surplus of consumers, K_0 is the previous price of gas, K_1 is the price of gas after the project is implemented, S_0 is the previous gas consumption, S_1 is the gas consumption after the project is implemented.

The situation as regards **electrical energy** is a bit different. The decision to change the import market or the energy production source is based by real difference between the respective alternative costs. In order to identify the alternative costs of the replaced and the replacement sources of energy, the long run marginal costs (LRMC) of production of electrical energy by using different sources and in different countries should be referred to.

Long run marginal costs are defined as the added cost of providing an additional unit of electrical energy. This reflects the social costs of production of such additional unit of electrical energy, subtracting the social value of additional profit due to the increased production. Since, due to their dependence on the level of the production capacity, long run marginal costs are usually unstable, they are considered to be the best basis for identification of the social value (cf. Drèze and Stern[178]).

The LRMC of production of electricity depend on the used sources (for instance, natural gas, water power, etc.) and multiple other factors, such as the used technology, production capacities, the time period of use of the equipment for production of electricity during the year, etc. Therefore the LRMC ratings are very dependent on the specific project and context, in which it is implemented and it is impossible to evaluate the overall LRMC ratings of production of electricity, which would fit the generalized cases. Thus such costs should be identified by the entity, implementing the project, by performing a separate study. The LRMC calculation methodology is provided in Annex 2.

In case of imported electrical energy the LRMC of production of electricity, performed abroad, should also include the incurred transmission costs. In case of production of electrical energy on the territory of Lithuania the LRMC should also include the costs for transportation of the fuel (for instance, imported natural gas) up to the electricity production facilities. Table **Error! Reference source not found.**1 shows the average piece costs of energy transportation on the territory of Lithuania.

Table 51. Energy transportation piece costs according to the prices of 2013

Energy product / fuel	Transportation costs	Source
Electrical energy transmission costs (high voltage)	1.88 ct/kWh	National Commission for Energy Control and Prices
Electrical energy distribution costs (medium voltage)	4.07 ct/kWh	National Commission for Energy Control and Prices
Electrical energy distribution costs (low voltage)	5.35 ct/kWh	National Commission for Energy Control and Prices
Costs of transportation of gas to Lithuanian energy production facilities	0.0471 LTL/m^3	National Commission for Energy Control and Prices
Costs of transportation of liquid fuel to Lithuanian energy production facilities	222.53 LTL/t	JASPERS, 2011

Source: BGI Consulting and CSIL Milano

The benefit, provided by the reduction of costs of heating energy as the result of replacement of the source of energy is also recommended to be evaluated in terms of differences of long run marginal costs (LRMC), i.e. the approach is similar to that in case of electrical energy.

[178] Drèze, J. and Stern N. (1990) 'Policy reform, shadow prices and market prices', Journal of Public Economics, 42 (1): 1-45.

Comparison with other countries. The electrical energy transmission and fuel transportation costs are standard and should not be very different by different countries, while the LRMC differences can be enormous. Such differences can be explained by the differences of energy sources, used for production of electrical energy and the energy production technologies. For instance, Sweden characterizes with very low electricity production costs due to the available atomic power plants, able to produce electrical energy at lower cost than other energy sources.

Application instructions

The approach, applicable to natural gas. The benefit, provided in case of replacement of the source of import of natural gas is suggested to be evaluated in terms of increase in consumers' surplus due to the reduction of gas prices (referring to the ½ rule). The feasibility study should reveal the following:

- The extent of reduction of the price of natural gas, paid by the consumers (LTL/m^3);
- The extent of increase in gas consumption.

In case the said information is available, the ½ rule is applicable (the formula is provided above). It is necessary to have in mind that the application of the ½ rule is based on the strong assumption that the overall reduction of costs is reflected in the reduction of the final price to consumers, which is actually a rare case. The gas supply costs' reduction may be in part reflected by the increase in the operator's profit (which, as such, is not considered an economic benefit) or by the increase in prices or can result in other macroeconomic consequences. Due to that the consumers' surplus is likely to be lower than the reduction of gas supply costs.

The approach, applicable to electrical energy. LRMC ratings are very dependent on the specific project and context, in which it is implemented therefore such costs should be identified by the entity, implementing the project, by performing a separate study. The LRMC calculation methodology is provided in Annex 2.

The benefit of replacing of the existing source of energy by another one, which is more acceptable, should be evaluated referring to the LRMC and transportation costs. Specifically, taking into consideration the different types of projects, relevant to Lithuania, the evaluation can be performed in the way, described below:

- In case the project covers diversification of import of energy by constructing a new energy link with Sweden or Poland, the benefit of import of cheaper electrical energy from the said countries should be calculated as the difference between the average LRMC of the replacement energy (i.e. that received from Sweden of Poland) and the LRMC of the replaced energy, also adding the transmission costs. It would be rational to expect that the most expensive electrical energy is going to be replaced.
- In case the project foresees construction of a new power plant in Lithuania in order to replace a share of imported electrical energy, the benefit should be calculated as the difference between the costs of production of electrical energy in Lithuania by using a specific energy source and the costs of imported replaced electrical energy, adding, where relevant, the transportation costs (see Table 51). It would be rational to expect that the produced electricity is going to be used to replace the most expensive imported electricity. In that case, the energy, produced by the power plant, will push out not a specific source of energy, but rather a totality of different sources, used for production of electricity in the country, from which it was imported. Therefore the LRMC of

electrical energy, produced as the result of the project should be compared with the weighed average of the electrical energy production costs in the country, from which it was imported.

- In case the project foresees modernization of a power plant in Lithuania in order to replace a source of energy by another one (less expensive fuel or a renewable source), the effect of the project should be evaluated as the difference between the production costs of the electricity, which will be produced as the result of the project and the costs of production of electricity by using the replaced source, adding the transportation costs, where relevant (the transportation costs' ratings are provided in Table 51). It should be noted that production of electricity by using a renewable energy source can be more expensive than using other sources. Due to that the project may result in a loss, rather than benefit. Notwithstanding that, the costs (fully or partially) will be compensated by the benefit, received from the reduction of emission of greenhouse gases and contaminants (described in chapters below).

The approach, applicable to heating energy is similar to that, applicable to electrical energy.

4. Improvement of buildings' energy characteristics

The projects, foreseeing reconstruction or modernization of apartment or public buildings, can result in benefits due to the improvement of buildings' energy characteristics, manifesting through increasing warmth comfort and / or reduction of heating costs. The element of improvement of buildings' energy characteristics will reflect the increased warmth comfort, while the reduced heating costs will be recalculated to economic price by applying the respective conversion rate.

Calculation methodology

The projects, aimed at improving buildings' energy characteristics, usually cover facades and roofs insulation works, replacement of windows and improvement of the heating systems. The project can have a twofold effect: first, increase in the level of indoor temperature and the resulting comfort and, second, reduction of energy consumption costs.

It is logical to assume that the usual temperature in non-renovated buildings in Lithuania during the cold season is 18°C or lower. The 18°C is the minimum temperature, recommended by the legal acts of the Republic of Lithuania and by the World Health Organization however this temperature is not always ensured in buildings, not manifesting with good energy efficiency. It is quite frequently avoided to raise temperature in such buildings in order to receive lower electricity bills. In this context Lithuanian energy investment projects, depending on specific intervention, may result not only in reduction of costs of use of energy, but also in increase in indoor temperature and thus the overall comfort.

In Lithuania in renovated buildings the temperature of 22°C is usually maintained, in case the residents have no possibility to adjust the temperature in each apartment/room, or 18–25°C, if the residents can freely adjust the temperature according to their preferences as regards their comfort or economic expenses.

The financial analysis allows for registering additional or reduced financial costs of energy consumption, compared to the situation in case the project is not implemented however it does not take into consideration the social and economic effect on the comfort. Meanwhile it is important, in the economic analysis to evaluate both cost savings and the benefit, brought by comfort. The suggested evaluation methodology consists of the following steps:

- A counterfactual scenario is provided, in which the energy consumption must be of the level, ensuring the standard comfort indoor temperature (22°C in Lithuania). It should be noted that such energy consumption level must reflect the building's energetic efficiency characteristics *before* implementation of the project;
- Any energy consumption cost changes are measured compared to the defined counterfactual situation. Such changes are evaluated by shadow prices by applying the conversion rates, calculated for electrical energy, natural gas, diesel fuel and oil products, included into the project costs (in this case the costs for the fuel, used for buildings' heating).

This methodology allows for evaluating the full benefit of improved buildings' energy characteristics, expressed in the comfort and cost changes. The example of application is provided below in the Application Instructions chapter.

Comparison with other countries. There is no available information on the empirical evaluation of improvement of buildings' energy characteristics in Lithuanian or other countries projects' CBA. The potential reason for that is that the projects of this category are frequently below the investment costs' ceiling, for which the CBA is required. Notwithstanding that in case of the need to perform the CBA the provided methodology may be applied to any country.

Application instructions

In order to apply the suggested methodology, used for evaluation of benefit, resulting from the improved buildings' energy characteristics, the following data are needed:

- The energy consumption level, necessary in order to ensure the buildings' warmth comfort in a counterfactual situation and the temperature, selected in the project implementation scenario. In each specific case the project evaluator should, with the help of experts, evaluate the energy consumption costs at the 22°C temperature (in the counterfactual situation in case of increase in the comfort) and the actual temperature, foreseen to be kept inside the building after the project is implemented.
- The conversion rate, applicable to energy costs, in order to convert the energy's market prices (used in the financial analysis) into economic shadow prices, reflecting the real alternative costs of the resources.

Below you will find simplified examples of evaluation of the benefit, received after improvement of buildings' energy characteristics in Lithuania, reflecting the differences of the results of application of the suggested methodology and the results of the financial analysis.

Insert 13. Examples of evaluation of improvement of buildings' energy characteristics

For instance, we analyze a project, covering façade insulation and replacement of the heating system. Let us say, the owner of non-renovated building each year pays 1,000 monetary units for the energy, necessary to keep the 18°C temperature. The assumption is made that the project is aimed at increasing the indoor temperature (from 18°C to 22°C warmth comfort temperature) at the same cost (1,000 monetary units) as before the project. The financial analysis would not reflect any cost savings but, viewing from the economic perspective, the energy costs, necessary in order to keep the 22°C warmth comfort temperature in the counterfactual scenario, are higher than those in the scenario, where the project is implemented (due to the improvement of the energy characteristics). For instance, in the counterfactual scenario such costs would be equal to LTL 1,200. Therefore there would come the benefit, relating to the comfort, resulting from higher indoor temperature, which cannot be expressed in the energy prices' system. Such benefit would be equal to:

$$\text{Benefit} = (1{,}200*0.8)–(1{,}000*0.8)= 160,$$

where 0.8 reflects that the economic analysis should take into consideration the alternative costs when applying the conversion rate, which is equal to 0.8.

Source: BGI Consulting and CSIL Milano

Estimate update instructions

In the counterfactual scenario the applied standard 22°C temperature remains relevant also for the next programming period (2014–2020).

5. Reduction of emission of carbon dioxide (as a greenhouse gas)

Different phases of energy's cycle from the construction of energy production equipment, its operation and ending with operation termination induces intensive emission of greenhouse gases (GHG). The main GHG, emitted to the Earth's atmosphere as the result of implementing energy projects, are carbon dioxide (CO_2) and methane (CH_4). The projects, covering modernization or construction of new power plants or energy supply systems or renovation of buildings, may result in changes of the GHG emission levels due to replacement or saving of fuel compared to the scenario in case the project is not implemented. Those are typical external costs or benefits (depending on whether the project results in increase or reduction of the emission), which must be considered when performing the economic analysis.

Calculation methodology and calculated estimate value

In accordance with the Kyoto protocol the EU Member States took actions in order to reduce the GHG emission, which is considered one of the principal reasons behind climate changes and the global warming. Lithuania set the goal to reach that before 2020 the GHG emission in the sectors, not participating in the EU Emissions Trading System, increases by not more than 15 %, compared with the level of 2005, and is equal to not more than 18.7 million tons of the CO_2 equivalent. This goal is planned to be reached by replacing the fossil sources of energy with renewable energy sources, as well as by reducing the energy loss and increasing the power plants' efficiency.

It should be noted that power plants of all types, even those using renewable sources of energy emit GHG. Therefore, in order to identify whether the project induces positive or negative GHG emission changes, it is necessary to evaluate the respective external costs and compare them with the costs in the counterfactual scenario.

One of the ways to include the GHG effect into the economic analysis of energy projects is to evaluate the emission costs referring to the market price of emission permits, which must be purchased by the operator. By applying this approach, the costs, avoided as the result of reduction of the emission, which would be later dedicated for procuring the permits, would reflect the economic value of this benefit. Nevertheless, due to misrepresentations of the EU Emissions Trading System, as emphasized by the European Investment Bank[179], the price of permits may not be considered a reliable expression of economic costs of emission.

Therefore the GHG emission as the result of Lithuania's energy projects should be evaluated by multiplying the amount of emission to the atmosphere (expressed in tons of CO_2 equivalents per year) of the project (additionally, compared to the scenario where the project is not implemented) by the piece value of the economic cost. The suggested method is identical to the GHG emission reduction evaluation method, suggested for the transportation sector's projects, i.e. **the element of reduction of emission of carbon dioxide (as a greenhouse gas) and its ratings are the same as those, described in the chapter, dedicated to the transportation sector (element "6. Reduction of emission of carbon dioxide (as a greenhouse gas)").**

Application of the element and rating to the energy sector

Application instructions of the benefit element's rating are similar to those, provided in the chapter, dedicated to the transportation sector. The amount of emission of carbon dioxide (CO_2) must be multiplied by the piece rating of the cost of emission of CO_2. Thus the monetary value of the effect is obtained.

The effect of the project on the amount of the GHG emission (including the CO_2), referring to the results of modelling, should be provided in the feasibility study, especially in the environmental impact evaluation report (if required). In this case the identified effect should be taken into consideration when performing the economic analysis. Notwithstanding that, in case the amount of emission, relating to the energy project under evaluation is unknown, the reference values, provided in the sector's literature and previous studies, may be referred to. For instance:

- The CASES database provides the amounts of emission by different types of electrical energy and heating production equipment and technologies, operated on the basis of very various sources of energy (provided in Annex 4).
- Natural gas pipelines may also bring the emission. Such emission is analyzed in the Guidelines of the Intergovernmental Panel on Climate Change (IPCC) of 2006 and provided in Annex 4 for convenience.

6. Reduction of emission of methane (as a greenhouse gas)

Apart from carbon dioxide (CO_2), methane (CH_4) is also considered a greenhouse gas. In order to reflect the methane (CH_4) emission costs, the emission of CH_4 in tons must be recalculated to the CO_2 equivalents. For

[179]EIB – European Investment Bank (2013), "The Economic Appraisal of Investment projects at the EIB", Luxembourg.

this purpose the global warming potential (GWP) rate is used[180]. As in case of the environmental protection sector, the rate, used for recalculation of emission of methane (CH_4) (in tons) to the carbon dioxide (CO_2) equivalent is 25[181].

Application of the element and the rating to the energy sector

The benefit element's rating application instructions are similar to those, provided in the chapter, dedicated to the environmental protection sector. The effect of the project on the amount of emission of the GHG (including the CO_2), referring to the results of modelling, should be provided in the feasibility study, especially in the environmental effect evaluation report (if required). In case the amount of emission, relating to the energy project under evaluation is unknown, the reference value should be searched for in the sources of information, provided for the previous element ("5. Reduction of emission of carbon dioxide (as a greenhouse gas)").

7. Air pollution changes

Apart from the GHG emission, burning of fuel also emits contaminating compounds, bringing negative effects on human health, quality of the environment and security of the ecosystem, preservation of trees, quality of harvests, etc. Modern equipment has filters and combustion control devices, reducing emission of hazardous contaminants down to the limits, prescribed by the EU legal acts. It is necessary to duly evaluate the residual damage costs.

Noise pollution is not considered a significant cost in energy projects, therefore the rating's piece valuation is not provided in the present document. In the CBA practice the residual damage costs of soil and water pollution are also not taken into consideration (as stated, for instance, in the EIB Guidelines[182]) due to its relatively insignificant importance.

Calculation methodology and calculated estimate value

Similarly as in the case of evaluation of the GHG emissions, resulting from implementation of energy projects and the reduction of air pollution, resulting from implementation of transportation projects, the monetary value, reflecting the energy projects' pollution costs, attributable to the additional amount of pollution, resulting from implementation of the project, must be established, compared with the counterfactual situation.

The list of contaminants, emitted when implementing energy projects:

- Nitric oxides (NO_x);
- Sulphuric dioxide (SO_2);
- Hard particles (SP10 and SP2.5);

[180] The rate reflects the amount of CO_2, which should have the same global warming potential as one unit of CH_4, measured during a certain period.

[181] Since energy projects' time horizon is usually longer than 20 years, the value of global warming potential (GWP), 25 times higher than that for CO_2, should be applied with regard to methane (CH_4).

[182] EIB – European Investment Bank (2013), "The Economic Appraisal of Investment projects at the EIB", Luxembourg.

- Non-methane volatile organic compounds (NMVOC), so-called ozone (O_3) precursors;
- Ammonium (NH_3).

The main reference study, providing piece valuations of air pollution in the EU Member States, is ExternE. The ExternE methodology allows for evaluating the damage of different contaminants, emitted when performing energy projects, to human health. Table 52 shows the costs, reflecting the increase in emission of specific contaminant by one ton, applicable to Lithuania. Depending on whether the emission occurs higher or lower than 200 meters above ground, different piece valuations are applied.

Table 52. Projects pollution costs, recommended for Lithuanian energy projects (LTL per one ton of emitted contaminant) according to the prices of 2013

Contaminant	Economic value	
	Low emission	High emission
NO_x	13,801	11,351
SO_2	13,729	12,531
SP_{10}	2,067	879
$SP_{2,5}$	46,380	21,928
NMVOC	214	214
NH_3	8,657	8,657

Source: BGI Consulting and CSIL Milano according to the information, provided by the Extern-E (EcoSenseLE model)[183].

Notes: if the contaminants are emitted higher than 200 m above ground, the values, applicable to high emission, shall be used. Otherwise the values, calculated for low emission, shall be applicable. The ExternE values reflect the situation as of 2010 however they were recalculated to the values as of 2013 according to the inflation data, provided by the International Monetary Fund (IMF) (the data of "World Economic Outlook", October 2013).

Comparison with other countries. Piece costs of each energy projects' contaminant differ by the country, since they depend on such variables, as weather conditions, the number of residents, experiencing the pollution, the value of human life, already existing pollution (its amount and distribution in space) and the preferences, expressed by well-informed inhabitants, affected by the pollution. By applying the ExternE model, ratings of pollution costs can be obtained for specific countries. For comparison, the piece economic valuation of emission in Lithuania is similar to that in Latvia, higher than that in Estonia and Finland and significantly lower than that in Poland, Italy, Germany and Bulgaria.

Application instructions

The practical evaluation of changes of contaminants' emission in Lithuania includes the following two steps:

i. *Identification of the amount*. In order to define the increase or reduction of the amount of emission, it is important to establish the amount of emission of contaminants in the scenarios

[183] Freely available online at: http://ecoweb.ier.uni-stuttgart.de/ecosense_web/ecosensele_web/frame.php

where the project is or is not implemented. As in case of the GHG emission, the information about the project's effect on the amount of contaminants' emission, based by results of modelling, should be searched for in the feasibility study, especially (if required) in the environmental effect evaluation report. In that case the effect, stated in the said documents, should be considered when performing the economic analysis. In case the amount of emission, relating with the energy project under evaluation was not evaluated, the reference values, provided in the sector's literature and in the previous studies, may be referred to. For instance:

- The CASES database provides the amounts of emission by different types of electrical energy and heating production equipment and technologies, operated on the basis of very various sources of energy (provided in Annex 4).
- The Guidelines of the Intergovernmental Panel on Climate Change (IPCC) of 2006 provide the amounts of non-methane volatile organic compounds, emitted by gas pipelines. The amounts of other contaminants are not evaluated, since they are not significant (more detailed information is provided in Annex 4).

ii. *Evaluation:* the contaminants emission costs are calculated by multiplying the amount of emission by the emission piece costs, provided in Table 52.

Estimate update instructions

The ratings' piece valuations, provided according to the prices of 2013, are considered fixed and should not be adjusted, with the exception of the case when a newer version of ExternE EcoSense model appears. All updates of the ExternE methodology are usually published at the project's webpage at http://www.externe.info/externe_d7/.

The entity, evaluating the project, should apply updated ExternE piece valuations for the said contaminants' costs, in case they are *significantly* different from those provided in Table 52. A difference, greater than 10 %, shall be considered sufficiently significant however the entity, evaluating the project, should be allowed to apply updated values in case of smaller difference between the old and new piece costs' valuations.

As suggested for the case of GHG emission, taking into consideration the advanced technological changes, the latest data on the amounts of contaminants should be referred to.

8. Reduction of number of accidents

Energy sector's projects characterize with the risk of accidents, which may result in injuries or death. Therefore the benefit, relating with the reduction of number of accidents, must be appropriately evaluated. The risk of accidents in energy projects covers the entire chain, including the extraction, production, processing, storage, transportation and waste handling. In the specific case of Lithuania, it can be relevant to evaluate the risk of accidents, relating to:

- Gas pipeline projects, where there is risk of gas explosions,
- Electricity transmission and distribution projects,

- Transportation of oil, in case the oil is used in the scenario, where the project is not implemented and is replaced with less dangerous fuel in the scenario, where the project is implemented.

Calculation methodology and calculated estimate value

The methodology of calculation of the avoided costs, relating with those injured when participating in energy projects, is similar to that, applicable for the transportation and health sectors. The following formula is applicable for calculating the costs, relating to injuries or deaths:

$$\textit{Accident costs} = e * p * c$$

where e is the number of persons, facing the risk of accident, p is the probability of the accident and c is the piece social cost, relating to injuries and deaths.

As suggested by the IER[184], when evaluating the probability of death the method of value of a statistical life (VSL) may be applied. Specifically, the economic costs of deaths and severe injuries, used for energy projects, are the following:

- **Deaths:** the deaths, resulting from the accident;
- **Severe injuries:** long-term injuries, where the injured person must be treated at a hospital (however the person does not die during the death registration period).

The values of accidents are the same as those, provided in the chapter, dedicated to the transportation sector (element “3. Reduction of number of accidents“) and, calculating according to the prices of 2003, are the following:

- **LTL 1,219,441 in case of death;**
- **LTL 174,577 in case of a severe injury.**

The number of persons, who, when working on the project, may experience an accident, is different depending on the specific project and may also change with time.

The probability of an accident also depends on the specific project. Due to that reason such probability must be identified in each specific case referring to the historical accident data and the technical-engineering aspects. It should be noted that the probability of accidents is likely to reduce in the future, since more modern equipment, allowing for increasing the security and reducing the frequency of accidents, is going to be used.

Application of the element and rating to the energy sector

The first step when evaluating the reduction of accidents is identification of the number of avoided deaths and severe injuries. The risk of accident is well defined – it includes the probability factor, based by the historical accident data and technical characteristics. The necessary data may be obtained from the engineers, responsible for designing and construction.

[184] IER – Institute for Energy Economics and the Rational Use of Energy (2004), “New Elements for the Assessment of External Costs from Energy Technologies”, Final Report to the European Commission, DG Research, Technological Development and Demonstration.

In case the annual number of persons, experiencing the risk of accidents and the probability of accidents in the scenario, where the project is implemented and in case the project is not implemented is available, it is possible to evaluate the benefit, resulting from the reduction of the number of accidents during the year.

1.5.4. The table of ratings of socio-economic effect in the energy sector

To summarize, the identified ratings of the socio-economic effect are shown in the table, provided in the Technical Task (Table 53). According to the requirements, provided in the Technical Task, the table must be related to the conversion rates, established by the service provider in order to ensure that no double-counting of benefits and damages occurs when calculating.

Table 53. The ratings of socio-economic effect, established for the energy sector

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload</th><th>Quantitative expression, LTL</th></tr>
<tr><td>Energy</td><td>N/a</td><td>N/a</td><td>1. Increase in reliability of electrical energy supply system</td><td>Avoided costs, relating to non-provided electrical energy (according to the prices of 2013)
<table>
<tr><th>Sector of economy</th><th>Cost of non-provided electrical energy (LTL/kWh)</th><th>Cost of non-provided electrical energy (ct/Kcal)</th></tr>
<tr><td>Industrial, including constructions</td><td>11.71</td><td>1.362</td></tr>
<tr><td>Commercial, transportation and public services</td><td>22.13</td><td>2.574</td></tr>
<tr><td>Agriculture, forestry and fishery</td><td>23.87</td><td>2.776</td></tr>
<tr><td>Residential</td><td>17.23</td><td>1.869</td></tr>
<tr><td>Entire country</td><td>12.23</td><td>1.423</td></tr>
</table></td></tr>
<tr><td>Energy</td><td>N/a</td><td>N/a</td><td>2. Increase in reliability of gas supply</td><td>Avoided costs, relating to non-provided gas (according to the prices of 2013)
<table>
<tr><th>Sector of economy</th><th>Cost of non-provided gas (LTL/m³)</th><th>Cost of non-provided gas (ct/Kcal)</th></tr>
<tr><td>Industrial, including constructions</td><td>97.08</td><td>1.177</td></tr>
<tr><td>Commercial, transportation and public services</td><td>619.57</td><td>7.510</td></tr>
<tr><td>Agriculture, forestry and fishery</td><td>130.33</td><td>1.580</td></tr>
<tr><td>Residential</td><td>258.52</td><td>2.923</td></tr>
<tr><td>Entire country</td><td>165.43</td><td>2.005</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload</th><th>Quantitative expression, LTL</th></tr>
<tr><td>Energy</td><td>N/a</td><td>N/a</td><td>3. Reduction of energy costs due to replacement of the source of energy</td><td>Natural gas. The evaluation is performed referring to the increase in surplus of consumers due to the reduction of prices of gas.
Electrical energy. The economic analysis evaluates the difference between the alternative costs of the replaced and replacement energy sources (long run marginal costs (LRMC)). Due to the large variation of the LRMC depending on the specific project, such costs should be identified by the entity, implementing the project during a separate study. In the cases, stated in the paragraph, dedicated to the specific element, it is also necessary to take into consideration the transportation costs, the ratings of which are provided below (according to the prices of 2013):
<table>
<tr><th>Energy product/fuel</th><th>Transportation costs</th></tr>
<tr><td>Electrical energy transportation costs (high voltage)</td><td>1.88 ct/kWh</td></tr>
<tr><td>Electrical energy distribution costs (medium voltage)</td><td>4.07 ct/kWh</td></tr>
<tr><td>Electrical energy distribution costs (low voltage)</td><td>5.35 ct/kWh</td></tr>
<tr><td>The costs of transportation of gas to Lithuania's energy production facilities</td><td>0.0471 LTL/m^3</td></tr>
<tr><td>The costs of transportation of liquid fuel to Lithuania's energy production facilities</td><td>222.53 LTL/t</td></tr>
</table>
Heating energy. The evaluation is similar to that in case of electrical energy.</td></tr>
<tr><td>Energy</td><td>N/a</td><td>N/a</td><td>4. Improvement of buildings' energy characteristics</td><td>The warmth comfort temperature in case of increase in the project beneficiaries' comfort, applicable in the counterfactual situation: 22°C.
The energy consumption costs at the temperature of 22°C (counterfactual situation in case of increase in comfort)</td></tr>
</table>

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload</th><th>Quantitative expression, LTL</th></tr>
<tr><td></td><td></td><td></td><td></td><td>should be evaluated by the entity, implementing the project with experts' assistance.</td></tr>
<tr><td>Energy</td><td>N/a</td><td>N/a</td><td>5. Reduction of emission of carbon dioxide (as a greenhouse gas)</td><td>LTL/ton CO_2
<table>
<tr><th rowspan="2">Year of application</th><th colspan="3">Economic value</th></tr>
<tr><th>Lower value</th><th>Medium value</th><th>Upper value</th></tr>
<tr><td>2010</td><td>28</td><td>86</td><td>169</td></tr>
<tr><td>2020</td><td>59</td><td>138</td><td>242</td></tr>
<tr><td>2030</td><td>76</td><td>190</td><td>345</td></tr>
<tr><td>2040</td><td>76</td><td>242</td><td>466</td></tr>
<tr><td>2050</td><td>69</td><td>293</td><td>622</td></tr>
</table>
</td></tr>
<tr><td>Energy</td><td>N/a</td><td>N/a</td><td>6. Reduction of emission of methane (as a greenhouse gas)</td><td>The rate for recalculation of emission of methane (CH_4) (in tons) into the carbon dioxide (CO_2) equivalent: 25.</td></tr>
<tr><td>Energy</td><td>N/a</td><td>N/a</td><td>7. Air pollution changes</td><td>LTL/ton of contaminant (according to the prices of 2013)
<table>
<tr><th rowspan="2">Contaminant</th><th colspan="2">Economic value</th></tr>
<tr><th>Low emission</th><th>High emission</th></tr>
<tr><td>NO_x</td><td>13,801</td><td>11,351</td></tr>
<tr><td>SO_2</td><td>13,729</td><td>12,531</td></tr>
<tr><td>SP10</td><td>2,067</td><td>879</td></tr>
<tr><td>SP2,5</td><td>46,380</td><td>21,928</td></tr>
<tr><td>NMVOC</td><td>214</td><td>214</td></tr>
<tr><td>NH_3</td><td>8,657</td><td>8,657</td></tr>
</table>
</td></tr>
<tr><td>Energy</td><td>N/a</td><td>N/a</td><td>8. Reduction of number of accidents</td><td>The values of accidents, calculated for Lithuania according to the prices of 2013 are the following:

LTL 1,219,441 in case of death;
LTL 174,577 in case of a severe injury.

</td></tr>
</table>

Notes: The indicators' table must be related to the conversion rates, established by the service provider in order to ensure that no double-counting of benefits and damages occurs when calculating.

1.5.5. Annexes (energy sector)

Annex 1. The benefit / damage elements, applicable to different types of projects

Project type	Applicable benefit (damage) components
1. Integration of electrical energy and gas networks into the EU electricity and gas energy systems	1. Increase in reliability of the electrical energy supply system 2. Increase in reliability of gas supply 3. Reduction of energy costs as the result of replacement of the source of energy 5. Reduction of emission of carbon dioxide (as a greenhouse gas) 6. Reduction of emission of methane (as a greenhouse gas) 7. Air pollution changes 8. Reduction of the number of accidents
2. Development of electricity, natural gas and heating transmission systems (construction of new ones) inside the country	1. Increase in reliability of the electrical energy supply system 2. Increase in reliability of the gas supply system 3. Reduction of energy costs as the result of replacement of the energy source 5. Reduction of emission of carbon dioxide (as a greenhouse gas) 6. Reduction of emission of methane (as a greenhouse gas) 7. Air pollution changes 8. Reduction of the number of accidents
3. Modernization of the domestic electricity, natural gas and heating transmission systems	1. Increase in reliability of the electrical energy supply system 2. Increase in reliability of the gas supply system 3. Reduction of energy costs as the result of replacement of the energy source 5. Reduction of emission of carbon dioxide (as a greenhouse gas) 6. Reduction of emission of methane (as a greenhouse gas) 7. Air pollution changes 8. Reduction of the number of accidents
4. Development of power plants, including those using renewable energy resources	1. Increase in reliability of the electrical energy supply system 2. Reduction of energy costs as the result of replacement of the energy source 5. Reduction/increase in emission of carbon dioxide (as a greenhouse gas) 6. Reduction/increase in emission of methane (as a greenhouse gas) 7. Air pollution changes 8. Reduction/increase in the number of accidents
5. Reconstruction of public and apartment buildings by improving the buildings' energy characteristics	1. Improvement of buildings' energy characteristics 2. Reduction of emission of carbon dioxide (as a greenhouse gas) 3. Reduction of emission of methane (as a greenhouse gas) 4. Air pollution changes

*Note: a specific project may not have all the above suggested effects.

Annex 2. Practical steps when calculating the long run marginal costs for electrical energy

The long run marginal costs (LRMC) are the costs of construction and operation of the power plant during the foreseen financial period of operation, expressed in litas per one kilowatt-hour (LTL/kWh).

The simplest way (chosen, for instance, by JASPERS) to calculate the LRMC is dividing the net present value of power plant cost flows during the reporting period by the discounted amount of the electrical energy, produced during the period. This method can be expressed by the formula below:

LRMC=(The costs, incurred throughout the entire time period of operation of the power plant)/(The amount of electrical energy, produced throughout the entire period of operation of the power plant)=(NPV(I+C+D))/(NPV(E))

where:

- I is the total investment cost for the power plant,
- C is the total of the power plant's operating cost,
- D is the cost of closing the power plant upon the expiry of its operation period,
- E is the total amount of electrical energy produced.

Specifically, in case of the discount factor $\sigma_t = \left(\frac{1}{1+r}\right)^t$, where r is the social discount rate and t is one specific year within the time horizon [0, …, t, …,T], corresponding to the power plant's year of operation, each of the elements above stated can be expressed in the way, showed below:

i. The total investment costs: $I = \sum_{t=0}^{T} i_t \cdot \sigma_t$. Those are the total of the discounted investment costs, incurred when constructing the power plant.

ii. The total operational costs: $C = \sum_{t=0}^{T} c_t \cdot \sigma_t$. This is the appropriately discounted added up amount of annual operational costs c_t (including the fuel costs), incurred throughout the entire time period of operation of the power plant. In order to simplify things, the assumption can be made that the annual operational costs are stable.

iii. The total power plant closing costs: $D = d_T \cdot \sigma_T$. Those are the costs of closing the power plant upon the expiry of its operation time period, discounted by applying the σ_T discount rate.

iv. The electrical energy produced: $E = \sum_{t=0}^{T} \varepsilon_t \cdot \zeta_t \cdot \sigma_t$, where ε is the nominal capacity of the power plant (expressed in MWh), and ζ is the power plant use (load) rate (expressed in %), showing the level of use of the power plant's capacities[185]. In order to simplify things, the assumption can be made that the amount of electrical energy, produced during a year, is stable. Additionally, the average value of the power plant's use (load) rate, foreseen throughout the entire time horizon, may be referred to.

Therefore, the principal elements, necessary in order to calculate the LRMC, are the following: the capital cost, costs of fuel and other constant and variable costs, closing costs, the power plant's nominal capacity and the foreseen power plant's use (load) rate.

The importance of the said elements differs depending on the technologies used. In case of solar or wind energy production technologies (when no fuel cost is incurred and the operation and maintenance costs are relatively low), the LRMC change in proportion to the foreseen capital costs. In case of technologies, requiring high fuel costs, both the fuel and investment costs will have a significant effect on the LRMC.

In order to simplify things, the costs to be taken into consideration when calculating the LRMC, may be expressed by market prices, not considering the shadow prices.

When calculating the LRMC different incentives, including tax deductions, are also not taken into consideration.

All of the said elements characterize with certain ambiguities. Due to changes of technologies and fuel prices, the elements' values may be significantly different in different countries and at different time. Therefore it is recommended to perform the sensitivity analysis of economic results of the CBA in order to evaluate how the economic results are affected by the changes of each element, used for calculating the LRMC.

As explained in the chapter, dedicated to element "3. Reduction of energy costs due to replacement of the energy source", the LRMC are taken into consideration when evaluating the benefit of reduction of electrical energy costs due to replacement of the energy source. Such evaluation is performed by taking the steps, listed below:

1. Calculating the project's LRMC:
    a. The features of the power plant, constructed under the project, are identified, such as the nominal capacity, the foreseen use (load) rate and time period of operation.
    b. The total amount of energy, produced by the power plant throughout its operation period is established, referring to the formula v above.
    c. All the financial investment costs, operational costs and closing costs for the power plant are established and discounted (the data, calculated according to formulas ii, iii and iv, can be obtained from the project's financial analysis).
    d. The LRMC of the power plant are calculated according to formula i.

2. Calculation of the "replaced" power plant's LRMC:

[185] For instance, if a 1 MW generator, operated at full power (8760 hours), is able to produce 8760 MWh of electrical energy during a year however its actual capacity use level is 57 %, the actual amount of electrical energy, produced by the generator per year, will be approximately 5000 MWh.

a. It is identified which source of energy will be replaced as the result of implementation of the project. That can be another power plant, existing in the same country, operated on the basis of another technology or by using another source of energy, or a power plant (operated on the basis of the same or another technology or by using the same or another source of energy), located in another country, from which the electrical energy is imported at the moment.

b. The features of the power plant, whose energy is going to be replaced as the result of implementation of the project, are identified, specifically its nominal capacity, use (load) rate and the foreseen operational life cycle starting from the moment of completion of construction. The data can be obtained by making a direct inquiry at the company, operating the power plant.

c. The total amount of electrical energy, produced by the “replaced” power plant throughout its operation life cycle is established according to formula v.

d. All the financial investment costs, operational costs and closing costs of the “replaced” power plant are calculated. The data on the investment costs can be obtained from the company, operating the power plant. In order to simplify things, the annual average of operational costs may be referred to. The data may also be obtained from the company, operating the power plant. The power plant’s closing costs may be calculated referring to the expert opinion or by making inquiry at the company, operating the power plant. All the costs must be added up and discounted to the year, in which the project’s CBA is performed.

e. The LRMC of the “replaced” power plant are calculated according to formula i.

If the LRMC of both the project and the “replaced” power plant are known, one can calculate the benefit of the reduction of electrical energy costs, resulting from implementation of the project referring to the rating application instructions for benefit element “3. Energy costs reduction as the result of replacement of the source of energy“.

Annex 3. Alternative methodologies for evaluation of the reliability of the electrical energy supply system

Different CBA methodologies, intended for evaluating the increase in reliability of supply of energy are provided in the literature and applied in practice. A short overview of the methodologies is provided below, dedicating the largest attention to their applicability in the context of Lithuania.

In rare cases the avoided compensation to consumers for the incurred losses due to energy supply interruptions is used as the reliability increase benefit rating. Nevertheless Lithuania does not have an automated compensation system, referring to which the operator would undertake to compensate the consumers for the direct losses incurred as per each kWh of non-provided electrical energy. In separate cases the compensation may be adjudicated by court. The lack of sufficient data on the avoided compensations for different types of consumers (in the industrial, commercial / services, residential sector, etc.) does not allow for using the methodology for evaluating the reliability of Lithuania's energy system.

Another methodology covers the identification of the consumers' willingness to pay for the avoided energy interruptions basing on the method of stated preferences, i.e. the electricity consumers are provided questionnaires, requesting to evaluate the damage, incurred in different energy supply interruption scenarios in terms of money (in case of different frequency and duration of interruptions, different seasons of the year, days of the week, time of the day, etc.).

The practical solution, frequently referred to when identifying the willingness to pay instead of the ad hoc surveys, is the benefit transfer method, according to which the willingness to pay, performed by survey based methods in other countries (contingent evaluation or choice modelling), could also be applied in Lithuania, by correcting the rating's value according to Lithuanian context. The overview of the existing surveys reveals that the identification of the willingness to pay is different in different surveys: the monetary value can be expressed as an average for the entire economy of the country or for individual sectors of economy; it can be considered a function of duration of interruptions (from several minutes to several hours) and their frequency; it can be defined as the number of kWh of non-provided energy or as a percentage of the electricity bill. Therefore it is not always possible to compare the results of different studies, identifying the willingness to pay, performed in different countries.

The ratings of willingness to pay for the increase in reliability of energy were calculated for the US (the entire country and individual states), North Cyprus, Austria, Canada, Brazil, Sweden, Nepal and Estonia. The values, calculated for Estonia are more suitable for obtaining the rating of willingness to pay among Lithuanian consumers by the benefit transfer method. This is determined by several reasons:

- The rates of growth of the GDP per capita (expressed by the purchasing power parity) is similar in Estonia and in Lithuania and this indicator is closely related with the values of the rating of willingness to pay;
- Estonia and Lithuania belong to the same electricity exchange, i.e. Nord Pool Spot;
- The study, performed by the researchers at Tallinn University of Technology, provides sufficiently detailed data on the monetary value of energy kWh for individual sectors of industry, commerce, agriculture and for the residential sector separately and jointly for all the sectors;

- The said study shows the non-provided energy costs, evaluated by different methods. Table 1 below shows the ratings, calculated for Estonia in 2003. The final ratings (provided in column 1) were calculated as averages referring to the consumer damage functions within the sector. The ratings were also calculated by dividing the sector's Gross Domestic Product (GDP) by the amount of electrical energy, sold to consumers in the sector and by dividing the annual household income by the annual household electrical energy consumption (the ratings, calculated by using this method, are provided in column 2). The ratings, provided in column 1, are higher than those in column 2, since the former are based by the results of direct surveys, revealing the respondents' tendency to overestimate the incurred expenses.

Table 1. Electrical energy interruption costs in Estonia (EUR/kWh) according to the prices of 2003

Sector	Column 1 Final ratings	Column 2 GDP and household income based ratings
Industrial	2.55	0.97
Commercial	3.6	2.68
Agriculture	2.37	1.01
Residential	2.35	1.65
Entire country	2.77	-

Source: BGI Consulting and CSIL Milano according to Raesaar, P., Tiigimagi, E., Valtin, J. (2005) "Assessment of electricity supply interruption costs in Estonian Power System", Oil Shale Pub.

Nevertheless the transfer of benefit, based by the willingness to pay, calculated for Estonia, would not result in acceptable ratings values, applicable to Lithuania, due to the following two reasons:

- Application of Estonia's final ratings of willingness to pay to Lithuania's context requires knowledge of damage functions of consumers in Lithuania's economy sectors in order to be able to model the interruption costs as an interruption duration function. However there is a lack of such functions in case of Lithuania, they could be evaluated only by way of direct survey;
- Even if assuming that the same damage function for consumers in economy sectors could be applicable to Lithuania, Estonia's ratings reflect the year of 2003, thus at present, due to the changes of Estonia's energy market and consumers' preferences during the last ten years, Estonia's ratings are not likely to be relevant.

Due to the said reasons the value of reduction of electrical energy provision interruptions in Lithuania was not established by the benefit transfer method. Instead, the costs of non-provided energy were calculated according to the gross value added (GVA) for one unit of consumed energy and according to the household income, as described in the chapter, dedicated to the element "1. Increase in reliability of electrical energy supply system“.

Annex 4. Emission of GHG and contaminants

The GHG and contaminants, emitted by electrical energy and heating production technologies

The CASES[186] provides the database of emission by all electrical energy and heating production technologies throughout their operational life cycle[187]. The data, provided in the CASES Life Cycle Inventory (LCI), cover all direct and indirect emission by different types of energy production technologies throughout their operational life cycle, including the processes of production and transportation of the materials, necessary for construction of the power plant, supply of fuel, operation and termination of the power plant.

The results are expressed by one kilowatt-hour (kWh) of produced pure electrical energy (i.e. the electrical energy, supplied to the network). A detailed description of the methodology is provided in other documents, prepared when implementing the project[188].

Table 1. Total amounts of emission by electrical energy and heating production technologies throughout their operational life cycle (kg/kWhel)

GHG and contaminants	Boiler oil condensation power plant	Light oil products gas turbine	Anthracite condensation power plant	Anthracite integrated combined gasification cycle	Lignite condensation power plant	Lignite integrated combined gasification cycle	Natural gas combined cycle	Natural gas, gas turbine
CO_2	1.92E-01	4.23E-01	7.61E-01	7.78E-01	9.07E-01	9.17E-01	4.02E-01	6.01E-01
CH_4	3.59E-04	4.25E-04	2.17E-03	2.22E-03	1.38E-04	1.39E-04	9.94E-04	1.50E-03
NO_x	3.14E-05	1.08E-05	3.30E-05	3.24E-05	2.89E-05	2.92E-05	1.02E-05	1.51E-05
SO_2	1.47E-03	9.90E-04	7.90E-04	4.70E-04	6.75E-04	2.79E-04	1.49E-04	2.55E-04
SP_{10}	2.94E-05	3.06E-05	7.38E-04	7.55E-04	2.05E-04	2.06E-04	6.16E-06	8.06E-06
$SP_{2.5}$	1.29E-05	1.28E-05	4.22E-05	1.57E-05	3.48E-05	2.23E-06	3.87E-06	5.03E-06
NMVOC	2.25E-04	2.79E-04	4.91E-05	4.34E-05	9.99E-06	9.89E-06	1.06E-04	1.53E-04
NH_3	2.05E-06	3.15E-06	1.64E-05	1.68E-05	7.87E-07	5.41E-07	2.29E-07	2.28E-07

Continued

GHG and contaminants	Low river water power, 200 kW	Medium river water power, 1 MW	High river water power, 50 MW	Dam (container) water power	Hydro accumulation water power	Land wind	Sea wind	Natural gas thermofication power plant with condensation steam turbine
CO_2	5.92E-03	4.23E-03	3.80E-03	7.23E-03	4.91E-03	9.78E-03	7.90E-03	3.67E-01
CH_4	7.02E-06	5.01E-06	4.51E-06	8.23E-06	5.41E-06	1.58E-05	1.31E-05	9.07E-04
NO_x	6.69E-08	4.78E-08	4.30E-08	8.62E-08	6.41E-08	3.25E-07	2.52E-07	9.28E-06
SO_2	1.32E-05	9.42E-06	8.48E-06	1.36E-05	7.71E-06	3.25E-05	2.85E-05	1.37E-04
SP_{10}	3.28E-05	2.34E-05	2.11E-05	4.40E-05	4.70E-05	9.06E-06	9.27E-06	6.11E-06
$SP_{2.5}$	2.60E-05	1.85E-05	1.67E-05	2.95E-05	3.16E-05	4.49E-06	5.49E-06	3.96E-06
NMVOC	1.66E-05	1.19E-05	1.07E-05	1.30E-05	4.40E-06	4.18E-06	3.59E-06	9.66E-05

[186]CASES – Costs Assessment for Sustainable Energy Markets, Project n° 518294 SES6, coordinated by the Institute of Energy Economics and the Rational use of Energy (IER) and cofounded by the EU Sixth Framework Programme.

[187]Deliverable n° D.2.1, version updated to 15th May 2008.

[188] The project‘s webpage: http://www.feem-project.net/cases/.

GHG and contaminants	Low river water power, 200 kW	Medium river water power, 1 MW	High river water power, 50 MW	Dam (container) water power	Hydro accumulation water power	Land wind	Sea wind	Natural gas thermofication power plant with condensation steam turbine
NH_3	1.56E-07	1.11E-07	1.00E-07	2.32E-07	1.86E-07	3.46E-07	3.25E-07	2.34E-07

Continued

GHG and contaminants	Anthracite thermofication power plant with a condensation steam turbine	Natural gas combined cycle thermofication power plant with a pressure proof turbine	Anthracite thermofication power plant with a pressure proof turbine	Biomass (straw) thermofication power plant with a condensation steam turbine	Biomass (wood) thermofication power plant with a condensation steam turbine	Molten carbonate fuel cells (natural gas)	Solid oxide fuel cells (natural gas)	Molten carbonate fuel cells (biogas)
CO_2	6.70E-01	4.01E-01	7.24E-01	1.14E+00	1.15E+00	1.45E-01	1.03E-01	3.17E-01
CH_4	1.91E-03	9.90E-04	2.07E-03	8.84E-05	5.63E-05	1.97E-03	2.00E-03	4.72E-04
NO_x	2.90E-05	1.01E-05	3.14E-05	7.14E-05	1.60E-05	3.01E-06	1.53E-06	1.07E-05
SO_2	6.96E-04	1.50E-04	7.52E-04	2.64E-04	1.43E-04	9.25E-04	3.22E-04	1.66E-03
SP_{10}	6.50E-04	6.57E-06	7.03E-04	2.83E-05	2.52E-05	5.82E-05	1.88E-05	2.26E-04
$SP_{2.5}$	3.71E-05	4.24E-06	4.03E-05	1.71E-05	2.01E-05	4.42E-05	9.90E-06	6.89E-05
NMVOC	4.32E-05	1.05E-04	4.67E-05	7.70E-05	3.05E-05	2.55E-04	2.06E-04	1.06E-04
NH_3	1.44E-05	2.50E-07	1.56E-05	4.95E-04	1.75E-06	3.29E-06	5.16E-07	8.79E-06

Source: BGI Consulting and CSIL Milano according to the information, provided by the CASES database (2008)

GHG and contaminants, emitted by gas pipelines

The emission by gas transmission and distribution technologies is evaluated in the Guidelines for National Greenhouse Gas Inventories of the Intergovernmental Panel on Climate Change (IPCC) of 2006. The contaminants emission amounts are provided only with regard to non-methane volatile organic compounds (NMVOC), since other contaminants are either not relevant or not identified.

Table 2. The amounts of emission by gas transmission and distribution technologies

GHG and contaminants	Gas transmission (uncontrolled emission)	Gas transmission (deliberate emission)	Gas distribution (full)
	Gg / 106 m3 of sold gas	Gg / 106 m3 of sold gas	Gg / 106 m3 of sold gas
CO_2	From 8.8E-07 to 2.0E-06 (ambiguity: from - 40% to + 250%)	From 3.1E-06 to 7.3E-06 (ambiguity: from - 40% to + 250%)	From 5.1E-05 to 1.4E-04 (ambiguity: from - 20% to + 500%)
CH_4	From 16.6E-05 to 1.1E-03 (ambiguity: from - 40% to + 250%)	From 4.4E-05 to 7.4E-04 (ambiguity: from - 40% to + 250%)	From 1.1E-03 to 2.5E-03 (ambiguity: from - 20% to + 500%)
NMVOC	From 7.0E-06 to 1.6E-05 (ambiguity: from - 40% to + 250%)	From 4.6E-06 to 1.1E-05 (ambiguity: from - 40% to + 250%)	From 1.6E-05 to 3.6E-5 (ambiguity: from - 20% to + 500%)

Source: BGI Consulting and CSIL Milano according to the information, provided in the Guidelines for National Greenhouse Gas Inventories of the IPCC of 2006

1.6. Development of Information Society

1.6.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.6.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The choice of elements of the socio-economic effects (benefit and damages) was based by the approved list of the types of projects in the information society development sector (Table **Error! Reference source not found.**).

Table 54. The types of projects in the information society development sector (as shown in the intermediate period report)

Project type	Project examples
1. Investments into the information technologies tools and solutions, required for provision of services in the electronic space	1.1. Transfer of public and administrative services into the electronic space 1.2. Investments into the systems, allowing for quick publishing or results in politics voting
2. Investments into the information technologies tools, content digitalization, necessary for development and dissemination of electronic content	2.1. Development of electronic culture content 2.2. The Lithuanian language in the information society
3. Investments into the information systems' interoperability	3.1. Investments into the hardware and software, necessary for development of the information systems interoperability
4. Investments into the information technologies security	4.1. Investments into the security of information technologies, used by institutions and organizations
5. Investments into the development of the information and communication technologies infrastructure	5.1. Development of broadband communication infrastructure 5.2. Development of public Internet access points infrastructure

Source: BGI Consulting and CSIL Milano according to the information, provided by the SFMIS, the strategic planning documents and the Information Society Development Committee under the Ministry of Transport and Communications of the Republic of Lithuania.

The principal effect of the projects of **Type 1** is **savings of time and funds as the result of use of electronic services instead of physical**.

The principal effect of the projects of **Type 2** is **the possibility to reach services electronically, without the necessity to travel to the physical service provision location.**

The principal effect of the projects of **Types 3 and 4** is **better functioning of the information systems**, manifesting in the reduction of time spent by the service user for performing one operation, the reduction of time of unavailability of the IS due to interruptions and maintenance works and the increase in data security (within the view of both integrity and privacy)**.**

The principal effect of the projects of **Type 5** is the possibility to use the broadband Internet, manifested by the willingness to pay for the Internet communication.

The detailed substantiation of choice of elements of socio-economic effect (benefit and damage) is provided below (Table 55).

Table 55. The arguments of choice of elements of socio-economic effect (benefit and damage)

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Savings of time and funds as the result of use of electronic services instead of physical	Direct effect	Referring to the EC Guidelines 2008 (3.3.4 "Telecommunications Infrastructure"), that is one of the two types of effects of direct information and telecommunications technologies projects. The CBA for the Lithuanian information society development projects usually state the benefit as rather significant[189]. This direct effect also corresponds to the national[190] and EU[191] strategic provisions, stressing the development of services, provided electronically and the increase in part of residents, using the services, thus saving the service users' time and reducing the monetary cost.
2. The possibility to reach the electronic content instead of	Direct effect	This direct effect corresponds to the strategic provisions of the EU and the UN. For instance the European Digital Agenda foresees saving of films in the digital format and creation of Internet access to such content[192] and the commission, launched at the UN initiative, recommends

[189] For instance: centralized transfer of municipal services to the electronic space; development of the taxpayers' electronic education, consulting and information services system.

[190] Cf. the criteria of evaluation of the Lithuania's National Innovation Development Programme 2014–2020.

[191] Source: http://ec.europa.eu/digital-agenda/sites/digital-agenda/files/KKAH12001ENN-PDFWEB_1.pdf.

[192] https://ec.europa.eu/digital-agenda/en/pillar-vii-ict-enabled-benefits-eu-society/action-81-issue-recommendation-digital-film.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
travelling to the physical service provision location		encouraging development of local content simultaneously with development of broadband Internet networks[193].
3. Better functioning of the information system	Direct effect	Better functioning of the information system, manifesting in the reduction of time spent by the service user for performing one operation, the reduction of time of unavailability of the IS due to interruptions and maintenance works and the increase in data security. This direct effect corresponds to the provisions of the national strategy, as well as to the EU and UN strategic provisions, stressing the need to ensure the information systems' interoperability[194] and security[195].
4. Willingness to pay for the Internet communication	Direct effect	Referring to the EC Guidelines 2008 (3.3.4 "Telecommunications Infrastructure"), that is one of the two types of effects of direct information and telecommunications technologies projects. This direct effect also corresponds to the national strategic provisions, emphasizing the increase in number of Internet users[196] and to the recommendation of the commission, launched by the UN initiative to make the broadband Internet available universally[197]. Consumers use the Internet services only in case the benefit surpasses the expenses, spent on the Internet communication[198], therefore the willingness to pay for the Internet usage reflects the benefits, provided by the possibility to use the Internet communication.

Source: BGI Consulting and CSIL Milano.

The table, provided in Annex 1, shows the benefit/damage elements, applicable to specific types of projects.

[193] Source: http://www.broadbandcommission.org/Documents/bb-annualreport2013.pdf (cf. Recommendation 7.9).
[194] For instance: http://www.broadbandcommission.org/documents/working-groups/bb-wg-taskforce-report.pdf (cf. Recommendation 8); https://ec.europa.eu/digital-agenda/en/our-goals/pillar-ii-interoperability-standards.
[195] For instance: https://ec.europa.eu/digital-agenda/en/our-goals/pillar-iii-trust-security.
[196] Cf. the criteria of evaluation of the Lithuania's National Innovation Development Programme 2014–2020.
[197] Source: http://www.broadbandcommission.org/documents/working-groups/bb-wg-taskforce-report.pdf (cf. Recommendation 1).
[198] Source: http://www.broadbandcommission.org/Reports/Report_2.pdf (cf. Chapter 3.2 of the Report).

1.6.3. Calculation Methodology and Application Instructions

1. Savings of time and costs as the result of use of electronic services instead of physical

The savings of time and costs are among the largest benefits, emerging as the result of electronic access to the services, which were previously provided physically.

The piece rating of the benefit element is equal to the electronic service users' willingness to pay for the possibility to use the services.

In the international practice the following two ways of evaluation of the willingness to pay are applied most frequently:

- First: the willingness to pay is identified referring to the ad hoc surveys, whose advantage is determined by focusing on the specific area of the project; however such surveys are quite expensive;
- Second (more frequently used): application of values, provided in the national and international studies.

The identification of the value of willingness to pay, applicable for Lithuania should be established by using a quite usual method, i.e. by calculating the value as the sum of the values of time and costs saved. Below, the said elements are analyzed individually.

Time savings calculation methodology and calculated value

Depending on the type of service, the consumers can use the service both during work and free time.

The time value calculation is almost the same as the one described in the chapter, dedicated to the transportation sector, with the exception of the aspect that in case of the information society development sector the adjustment rate, reflecting the fact that the persons who spent more for transportation are usually the ones who earn more, is not applied. Therefore the value of working time, applicable to the information society development sector**, calculating according to the prices of 2013, is LTL 19.30 per hour and the value of non-working time is LTL 7.72 per hour.** The values are lower than those provided in the section, dedicated to the transportation sector, since in the case of the transportation sector the object of analysis are transport users, who, more frequently, are those, receiving higher income, while the electronic services are usually used by all the groups of residents.

Money savings calculation methodology and calculated value

When calculating the money savings' values the following two groups of transport are distinguished: public and personal.

It should be mentioned that the monetary transportation costs also cover tariffs and levies.

In case of personal transport it is necessary to consider the vehicle's operating costs (VOC), which are defined as costs, incurred by the user while operating the vehicle.

The calculations of the personal vehicle operating costs are the same as those, described in the chapter, dedicated to the transportation sector, with the exception of the aspect that in case of the information society development sector the VOC reflect the willingness to pay therefore the indirect expenses are not deducted from the VOC's value. Thus, in case of the information society development sector the value of VOC, applicable to cars in Lithuania is LTL 0.83 per km[199] (with tolls). In order to obtain the vehicle's operating costs per one $user_n$ (LTL/km), the VOC must be divided by the average number of persons, travelling by cars, which, in Lithuania, are 1.2 travellers inside a car[200].

In case the used means of transportation does not require fuel and oils (for instance, a bicycle) or no means of transportation is required for the travel, the VOC are equal to 0.

The monetary costs, saved by users of public transportation are the price of the ticket.

Application instructions

In order to estimate the cost, emerging as the result of savings of time and money when using the electronic services instead of physical ones, it is important to know the distribution of users of electronic services against the used transport or at least the structure (in percentage) of the use of transport in the country or in the region/location under analysis, distinguishing personal cars, public transport and means of transportations, which do not require any fuel.

The following information is also necessary for the calculations:

- The number of instances of use of the services during a specific year (N);
- The average saved time of travel due to the avoided necessity to visit the physical service provision location (T_1);
- The time saved due to the avoided waiting in line at the physical service provision location (T_2);
- The time saved when performing the service provision operation (T_3);
- The average distance, travelled by the service users to the physical service provision location (A).

The time and money costs, saved during the year (year n) are equal to:

$V_n = N_{persransp} * PS_{perstransp} + N_{publictransp} * PS_{publitransp} + N_{othertransp} * PS_{othertransp}$

where:

- $N_{persransp}$ is the number of instances of using the service when travelling by a personal car;
- $N_{publictransp}$ is the number of instances of using the service when travelling by a public means of transportation;
- $N_{othertransp}$ is the number of instances of using the service when travelling by a means of transportation, which does not require any fuel;
- $PS_{perstransp}$ is the willingness of the user, travelling by a personal car, to pay, calculated according to the formula: $(T_1 + T_2 + T_3)*TM + VOC_n*A$;
- TM is the time value;

[199] The data, provided by Public Enterprise Road and Transport Research Institute

[200] The data, provided by Public Enterprise Road and Transport Research Institute

- $PS_{publictransp}$ is the willingness of the user, travelling by public transport, to pay, calculated according to the formula: $(T_1 + T_2 + T_3)*TM + K_{publictransp}$;
- $K_{publictransp}$ is the price of travelling by public transport;
- $PS_{othertransp}$ is the willingness to pay by the user, travelling a means of transportation, which does not require any fuel, calculated according to the formula: $(T_1 + T_2 + T_3)*TM$;

An example of calculations is provided in Insert 14.

Insert 13. Calculations of time and money costs' savings as the result of creation of electronic access to the services, which were previously available only in physical form

For instance, let us perform the analysis of time and money costs' savings as the result of creation of electronic access to the services to taxpayers, which were previously available only in physical form. The analysis shows that after the information to taxpayers is commenced to be provided electronically 500,000 information requests per year will be handled electronically, not physically (N = 500,000).

It was calculated that the average time, during which the service users reach the physical service provision location, is 25 minutes (T_1 = 25 min.) and the average time, spent while waiting in line at the physical service provision location is 20 minutes (T_2 = 20 min.).

In case of this example the assumption is made that if the service provision operation is performed electronically, no time will be saved (T_3 = 0).

After adding up the average travelling time saved as the result of avoided necessity to arrive to the physical service provision location (T_1), the time saved as the result of avoided necessity to wait in line at the physical service provision location (T_2) and the time, saved when performing the service provision operation itself (T_3), the total time saving is 45 minutes (0.75 hour).

Taking into consideration the type of service, the assumption is made that all the service users are natural persons, using the services not during the working time. Therefore the non-working time value, equal to LTL 7.72 per hour is applied.

The analysis showed that the structure of service users in terms of the type of used transport is the following:

- Personal cars = 50 %,
- Public transport = 30 %,
- Other transport = 20 %.

It was established that the average distance, saved by the service users is 15 km. The vehicle operation costs (VOC), applicable to a personal car, are LTL 0.83 per one kilometre (the assumption is made that the service user travels by car alone). The amount of LTL 4 is spent for public transportation tickets on the average.

The annual benefit of the project, resulting from time and money costs, saved by the users of electronic services is:

500,000 * 0.75 * 7.72 + 500,000 * 0.5 * 0.83 * 15 + 500,000 * 0.3 * 4 = 6,607,500 LTL

Source: BGI Consulting and CSIL Milano.

Estimate update instructions

It is recommended to update the rating values each year. The rating values' updating instructions are similar to the corresponding benefit elements Estimate update instructions, provided in the chapter, dedicated to the transportation sector.

2. The possibility to reach the electronic content instead of physical travel to the location

Development of electronic content is one of the most advanced innovations, relating with the spread of the Internet. The possibility to reach content electronically, without the physical necessity to travel to the location, creates significant economic benefits.

Calculation methodology

The economic value of satisfaction with content corresponds to the user's willingness to pay for the content. The value can be identified in case the analyzed service has a certain market value (for instance, a museum's economic value is shown by the price of the ticket). In case it is impossible to define the market value, the services' economic value must be identified by using other methods.

One of the ways to identify the service users' willingness to pay is ad hoc surveys, the advantage of which is determined by focusing on a specific project area however such studies are very expensive.

Another way to identify service users' willingness to pay is to refer to the travelling costs method, allowing for evaluating the user's willingness to pay according to the costs, which the user is willing to incur in order to get a possibility to use a certain service or goods. The usage costs cover the travelling and additional expenses at the service provision location, such as the vehicle parking toll or a ticket for entering the historical centre.

The evaluation methods, based by the willingness to pay are usually more difficult to apply, since they are based by evaluation of individual preferences. If possible, the cost based methods are more advisable to be used.

In order to attribute an economic value to the possibility to reach content electronically without having to travel to the location physically, the following three different situations are distinguished:

A. The content can be also reached via paid physical access (by paying for the ticket),
B. The content can be also reached via free-of-charge physical access,
C. The content can be reached only via electronic access, no physical access is available.

Situation A. The content, available electronically, can be also reached via physical access. The economic benefit of the value, provided by the possibility to use the electronic content, can be measured referring to the price of the ticket for the physical access as the rating of the user's willingness to pay.

Situation B. The content, available electronically, can be also reached via free-of-charge physical access. In this case the travelling costs method should be referred to.

The willingness to pay is calculated by adding up the value of the time, saved as the result of avoidance of the necessity to travel to the physical service provision location and the saved money.

The calculation methodology and application instructions are the same as those, applicable to time and money savings resulting from use of electronic services instead physical ones.

Situation C. The electronic content cannot be reached via physical access. In that case ad hoc surveys are the only way to calculate the willingness to pay.

Application instructions

In order to calculate the value of the benefit, resulting from use of electronic content instead visiting the physical content location, it is important to identify the number of times the content (N) is used during the analyzed time period (year n) and multiply the number by the calculated willingness to pay, as stated below:

$V_n = N * WP$,

where WP is the willingness to pay.

The example of calculations is provided in Insert 15.

Insert 14. The possibility to reach electronic content instead of travelling to its physical location

For instance, a project, falling within the category of Situation A is analyzed (the content can be also reached via paid physical access (by paying for a ticket)), i.e. a virtual version of a real existing museum, the price of ticket into which is LTL 20, is created.

It is forecasted that during a year the virtual museum will be visited by 500,000 persons (N = 500,000).

The virtual museum visitor's willingness to pay for the electronic content is equal to the price of the ticket, paid for entrance into the real (physical) museum, i.e. LTL 20.

The savings, resulting from the created possibility to reach the content electronically, without having to travel to the physical content location, amount to 500,000 * 20 = 10,000,000 LTL per month.

When analyzing a project, corresponding to Situation B, i.e. creation of virtual version of a real existing museum, the entrance into which is free of any charge, it is calculated that during the year the virtual museum will be visited by 500,000 persons (N = 500,000).

It is established that the average time, spent by the visitor in order to travel to the museum, is 25 minutes and the average time for waiting in line by the entrance is 5 minutes. Therefore the total time, spent by the visitors is 30 minutes or 0.5 hours ($T_1 + T_2$ = 30 min. = 0.5 hrs.).

Taking into consideration the type of services, the assumption is made that all the service users are physical persons, using the services not during the working time. Therefore the non-working time value, which is LTL 7.72 per hour, is applied.

The analysis showed that the structure of service users in terms of the type of used transport is the following:

- Personal cars = 50 %,
- Public transport = 30 %,
- Other transport = 20 %.

It was established that the average distance, saved by the service users is 30 km. The vehicle operation costs (VOC), applicable to a personal car, are LTL 0.83 per one kilometre (the assumption is made that the number of service users, travelling by one car corresponds to the average number of persons, travelling by cars, i.e. 1.2). The amount of LTL 4 is spent for public transportation tickets on the average.

The annual benefit of the project, resulting from time and money costs, saved by the users of electronic services is:

500,000 * 0.5 * 7.72 + 500,000 * 0.5 * 0.83 / 1.2 * 30 + 500,000 * 0.3 * 4= 7,717,500 LTL

Source: BGI Consulting and CSIL Milano

3. Better performance of the information system

Improvement or performance of the information system (IS) means improvement of the electronic services' quality parameters.

Calculation methodology and calculated estimate value

This analysis considers the following three IS quality parameters: the average time, spent by the service user for performing one operation, IS reliability, understood as the ability to provide services without interruptions and security of data.

Better IS performance is expressed by the following parameters:

- Reduction of the average time, spent by the service user for performing one operation (T_{oper}), expressed by hours for one operation,
- Reduction of the duration of IS idle time due to faults and reduction of the duration of maintenance works (T_{idle}), expressed, for instance, in hours per year,
- Increase in integrity of the data, evidencing the IS's ability to guarantee that the data will never be lost,
- Increase in privacy of the data, evidencing the IS's ability to ensure that no authorized persons can access the data.

The quantity parameters of the improvements, resulting from implementation of the project, should be provided in the project's technical documents.

Separate analysis of the economic estimation of improvement of each of the parameters is provided below.

The reduction of the average time, spent by the service user for performing one operation (T_{oper}) creates time savings for the user. The economic value of such savings (in year n) is calculated referring to the number of operations per year (N) and the time value, calculated previously (cf. the savings of time and money resulting from use of electronic services instead of physical ones):

$V_n = T_{oper} * N * TM$,

where TM is the time value.

The reduction of the duration of the IS's idle time due to faults and maintenance works (T_{idle}) evidences the improvement of the system's availability, the economic value of which is calculated referring to the willingness to pay (WP) for the provided IS services and the number of operations per hour (N_{hour}).

The willingness to pay (in year n) for performance of the operation and for the access to the services, provided by the IS or to the content, is calculated in accordance with the methodology, similar to that, applicable to the previous benefit elements:

$V_n = T_{idle} * N_{hour} * WP$.

The security of data (both in terms of integrity and privacy) allows for reducing the risk that the data is changed, lost or finds its way to unauthorized persons.

The economic risk reduction value can be calculated by referring to the principle of “avoided damage”.

The benefit is equal to the costs for remedying the damage, incurred in case the data is lost, damaged or finds its way to unauthorized persons.

In case of loss or damage of the data the costs for remedying the loss shall correspond to the costs for the following operations:

- Verifying the integrity,
- Loss of usefulness of the data till the data is restored,
- Acquiring new data.

In case the data finds its way to unauthorized persons, the said costs must also include the damage, resulting from the data being used by such unauthorized persons.

In both cases one must have in mind that the reduction of confidence in the IS's ability to protect the data and the users' privacy may result in the reduction of the number of users. In that case it is necessary to consider the reduction of the benefit, resulting from the use of services or electronic services, calculated in accordance with the methodology described above.

Additionally, attention must be drawn that the volume of avoided damage very much depends on the type of the data, handled by the IS.

Application instructions

When calculating the benefit, resulting from better performance of the IS, it is important to have in mind that the reduction of the average time, spent by the service user for performing one operation (T_{oper}) and the reduction of the duration of the IS's idle time due to faults and maintenance works (T_{idle}) shows the difference between the improved IS performance after the project is implemented and the IS performance in case the project is not implemented. It is important to provide an analysis of differences as regards both cases in the project's technical description.

The application instructions are illustrated by the example, provided in Insert 15.

Insert 15. Better performance of the information system

Example 1. Reduction of the average time, spent by the service user for performing one operation

For instance, the project is aimed at improving the electronic system providing the transport information. It is calculated that during the year the information system will process 10,000,000 transport information inquiries, including 40 % of inquiries for leisure purposes and 60 % for work related purposes.

Taking into consideration the project's technical data, it is calculated that the average time spent to obtain the information on the traffic on the specific road will be 30 seconds shorter (T_{oper} = 30 sec. = 0.0083 hour per operation).

The time value for the users, performing searches not for work related purposes, is LTL 7.72 per hour. Meanwhile the time value for the users, performing searches for work related purposes, is LTL 19.30 per hour.

The annual benefit, resulting from better performance of the IS is:

10,000,000 * 0.60 * 0.0083 * 19.30 + 10,000,000 * 0.40 * 0.0083 * 7.72 = 1,217,444 LTL

Example 2. Reduction of the IS's unavailability due to faults and maintenance works

For instance, the project is aimed at reduction of the duration of idle time of the electronic system, providing traffic information.

It is calculated that during the year the system will process 10,000,000 traffic information inquiries, by performing 10,000,000/8760[201] = 1, 141 operations per hour (N_{hour} – 1,141).

Taking into consideration the technical data of the project, it is established that the unavailability time will reduce by 100 hours per year.

For instance, the user's willingness to pay for one operation is equal to LTL 5.

The annual benefit, resulting from the reduction of duration of the idle time of the IS due to faults and maintenance works is:

100 * 1 141 * 5 = 570,500 LTL.

Source: BGI Consulting and CSIL Milano

4. The willingness to pay for the Internet communication

The projects, aimed at development of the broadband communication infrastructure or public Internet access points' infrastructure, create the possibilities to use broadband Internet communication. The economic piece rating of this benefit element is equal to the users' willingness to pay for using the broadband communication.

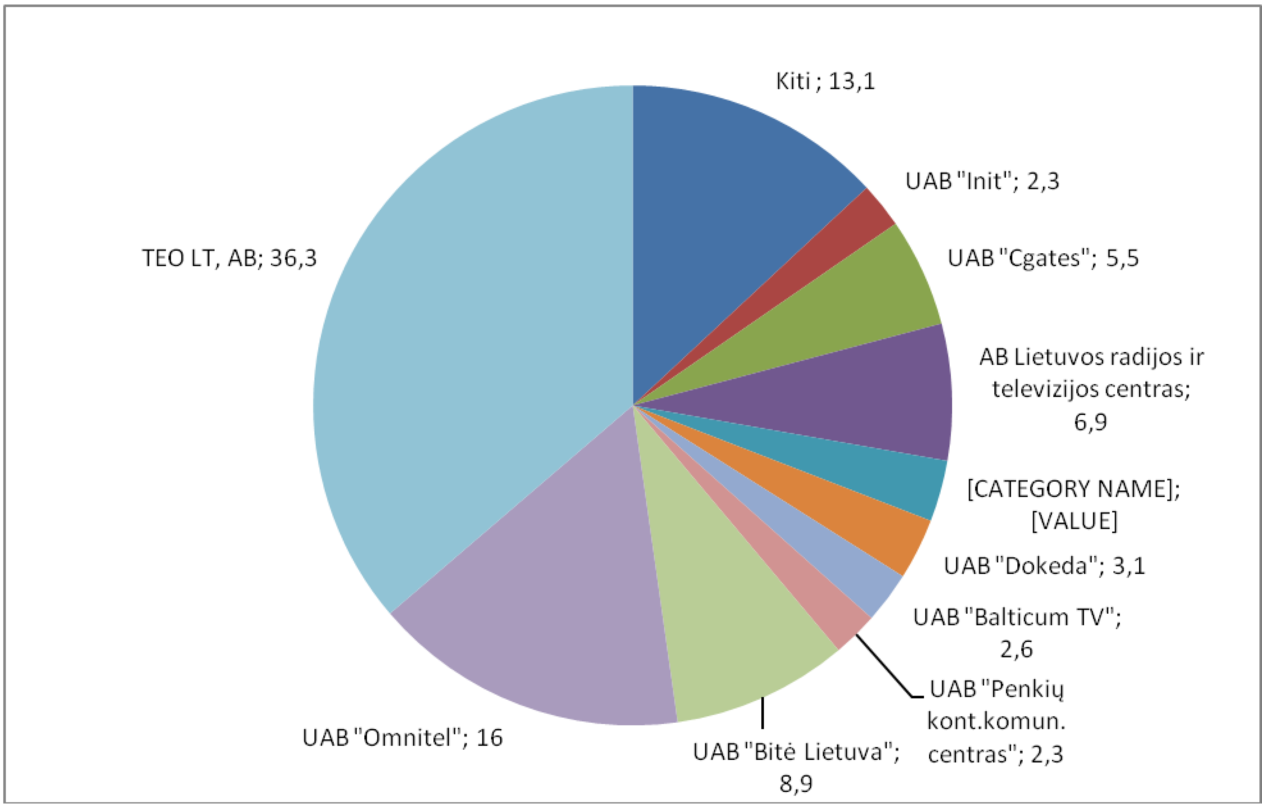
[201] 365 days * 24 hours = 8,760.

Calculation methodology and calculated estimate value

When the market is sufficiently free, the price, paid for the service, may be considered a suitable expression of the users' willingness to pay.

Referring to the data, provided by the Communications Regulatory Authority of the Republic of Lithuania, in the first quarter of 2013 there were 99 providers of broadband communication services.

The distribution of service providers against the occupied market shares (i.e. the number of serviced subscribers) as of the first quarter of 2013 is shown in Picture 1 below.



Picture 1. Distribution of service providers against the occupied market share (the number of serviced subscribers) as of the first quarter of 2013, % (the total number of subscribers is 1.070.000)

Source: BGI Consulting and CSIL Milano according to the data, provided by the Communications Regulatory Authority of the Republic of Lithuania

Referring to the data, provided by the Communications Regulatory Authority of the Republic of Lithuania, shown in Table 56, the average monthly price of the Internet communication services was reducing each year throughout the last five years' period.

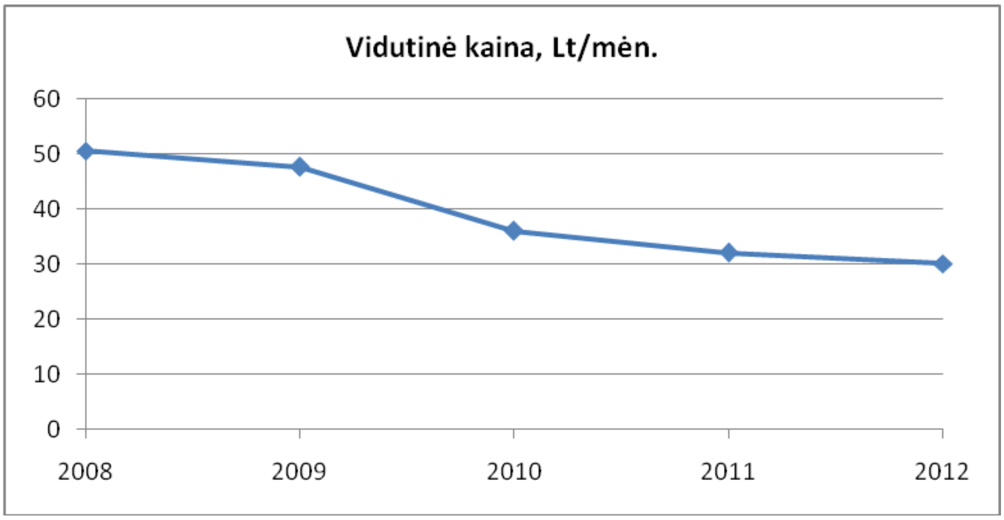
Table 56. Average prices of broadband communication services

Year	Average price (LTL per month)	Percentage change, compared to the previous year
2008	50.5	-
2009	47.6	- 5.7 %
2010	36.0	- 24.4 %
2011	32.0	- 11.1 %
2012	30.1	- 5.9 %

Source: BGI Consulting and CSIL Milano according to the data, provided by the Communications Regulatory Authority of the Republic of Lithuania

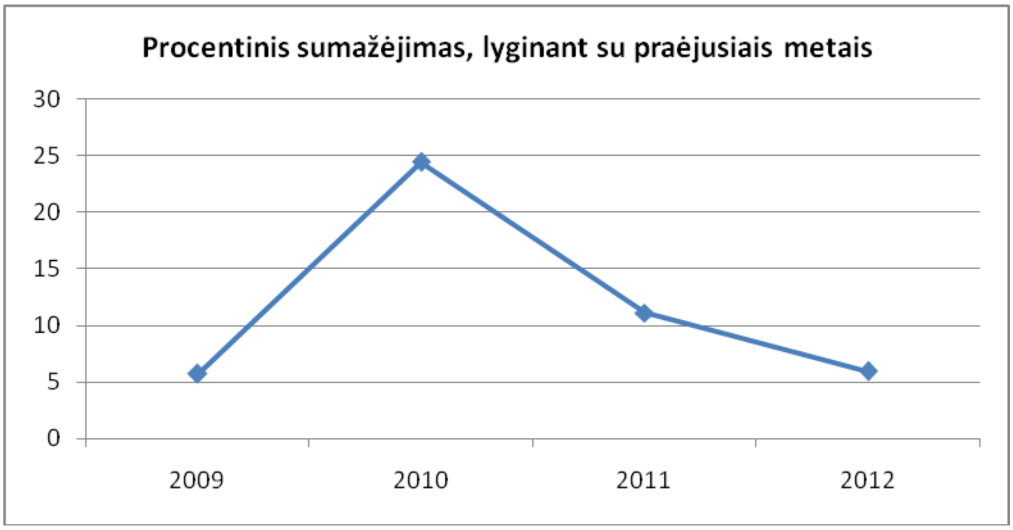
The reduction of the average monthly price of the Internet communication services is shown in Pictures 2 and 3.

Vidutinė kaina, LTL/mėn – Average price, LTL per month



Picture 2. The average prices of the broadband communication services

Source: BGI Consulting and CSIL Milano according to the data, provided by the Communications Regulatory Authority of the Republic of Lithuania



Picture 3. The percentage reduction of the average price of the broadband communication services, compared to the previous year

Source: BGI Consulting and CSIL Milano according to the data, provided by the Communications Regulatory Authority of the Republic of Lithuania

Taking into consideration the large number of operators and the price reduction trends during the last five years, the conclusion can be made that Lithuania's broadband communication market is sufficiently free and the average price, paid by the users can be considered their willingness to pay:

$$\mathbf{WP_{2012} = LTL\ 361.2\ per\ year}$$

This value is applicable for the year 2012, while the values, applicable for later years of the time period of the analysis, should be calculated by making the assumption that each year the price will change at the same rate as in the previous year, for which the information is available. Since at present such year is 2012, during which a 5.9 % price drop was observed, the same rate should be applicable when foreseeing the reduction of price throughout the period of analysis. In such way the average users' willingness to pay for broadband communication according to the prices as of 2013 would be:

$$\mathbf{WP_{2013} = LTL\ 339.9\ per\ year}$$

Application instructions

The established rating is suitable to be applied both as regards natural persons and legal entities, using the Internet communication. In case of legal entities the number of users is equal to the number of employees, using the Internet communication.

In order to calculate the value of the benefit, provided by the possibilities to use broadband Internet communication (V) in year n, the number of new users (N) is multiplied by the piece rating of the benefit element, reflecting the users' willingness to pay for the services (WP).

$V_n = WP * N$

An example of calculation of the benefit, provided by the possibilities to use the broadband Internet communication is provided in Insert 17 .

Insert 17. Example of calculation of the benefit, provided by the possibilities to use the broadband Internet communication

For instance, we analyze the project, aimed at development of broadband communication infrastructure, which will allow to connect 500,000 new users.

The new users' willingness to pay is LTL 339.9 per year per one user.

Thus, the annual benefit of the project is 339.9 * 500,000 = 169,950,000 LTL.

Source: BGI Consulting and CSIL Milano

Estimate update instructions

Taking into consideration the market dynamics, it is recommended to update the benefit element's rating value each year, in line with the data, published by the Communications Regulatory Authority of the Republic of Lithuania.

After the value is renewed, the piece benefit element's rating values, applicable to later years of the time period of the analysis should also be updated. For this purpose the price reduction trend, observed in Lithuania, should be considered (cf. Pictures 2 and 3 above) and coordinated with the trends, observed in other EU Member States.

The assumption is made that the price reduction rate throughout the coming period shall be equal to the reduction rate, observed during the previous year, for which such information is available:

[piece rating in year n] = [piece rating in year n-1] * (1-reduction rate)

1.6.4. The table of socio-economic effect ratings in the information society development sector

To summarize, the identified socio-economic effect ratings are provided in the Technical Task in the form of the established table (Table **Error! Reference source not found.**). According to the requirements of the Technical Task, the indicators' table must be related with the conversion rates, established by the service provider, in order to ensure that there is no double-counting of benefits and damages when calculating. Nevertheless the established ratings are not related with the conversion rates, applicable to the costs therefore there is no risk of double-counting of benefits and damages.

Table 57. The socio-economic effect ratings, established for the information society development sector

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload *(table of strong, reliable and significant ratings (at least three))*	Quantity expression, LTL
Information society developmen t	N/a	N/a	1.1. Time saving resulting from use of electronic services instead of physical services	Time value (according to the prices of 2013): • Working time value: LTL 19.30 per hour • Non-working time value: LTL 7.72 per hour
Information society developmen t	N/a	N/a	1.2. Savings of money resulting from use of electronic services instead of physical services	The value of VOC, applicable to cars: LTL 0.83 per km The price of the ticket, payable by users of public transportation services (established taking into consideration the specific object).
Information society developmen t	N/a	N/a	2. Possibility to reach the electronic content instead of the necessity to travel to the physical location	Time value (according to the prices of 2013): • Working time value: LTL 19.30 per hour • Non-working time value: LTL 7.72 per hour The value of VOC, applicable to cars: LTL 0.83 per km The price of the ticket, payable by users of public transportation services (established taking into consideration the specific object). The price of entrance ticket, payable for the physical access

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload *(table of strong, reliable and significant ratings (at least three))*	Quantity expression, LTL
				(depending on the specific object). The willingness to pay for the electronic content (established by way of ad hoc survey for the specific object)
Information society developmen t	N/a	N/a	3. Better performance of the information system	3.1. Reduction of the average time, spent by the service user for performing one operation: • Working time value: LTL 19.30 per hour • Non-working time value: LTL 7.72 per hour 3.2. Reduction of the duration of unavailability of the IS due to faults and maintenance works: • The user's willingness to pay for one operation (depending on the specific object). 3.3. Increase in security of data (avoided costs depend on the specific object).
Information society developmen t	N/a	N/a	4. Willingness to pay for the Internet communication	The average users' willingness to pay for the broadband communication (according to the prices of 2013): • LTL 339.9 per year

Notes:

* The indicators' table must be related with the conversion rates, established by the service provider in order to ensure that there is no double-counting of benefits and damages when calculating.

1.6.5. Annexes (information society development sector)

Annex 1. The benefit/damage elements, applicable to different types of projects

Project type	Applicable benefit (damage) components
1. Investing into the information technologies' tools and solutions, necessary for provision of services in the electronic space	1. Savings of time and money resulting from use of electronic services instead of physical services
2. Investing into the information technologies' tools and into digitalization of content, necessary for development and dissemination of electronic content	2. The possibility to reach electronic content instead of the necessity to travel to the physical location
3. Investing into the information systems' interoperability	3. Better performance of the information system (reduction of the average time, spent by the service user for performing one operation)
4. Investing into the information technologies' security	3. Better performance of the information system (reduction of the duration of unavailability of the IS due to faults and maintenance works; increase in the data security)
5. Investing into the development of information and telecommunication technologies' infrastructure	4. Willingness to pay for the Internet communication

1.7. Environmental Protection

1.7.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.7.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The selection of benefit (damage) components was based on the approved list of general environmental sector project types (Table 58).

Table 14. Chosen types of projects of general environmental protection sector

Project type	Project examples
1. Renovation and development of water supply and waste water treatment systems	1.1. Renovation / development of water supply infrastructure 1.2. Renovation / development of wastewater treatment infrastructure 1.3. Investments into infrastructure for rainwater
2. Development of municipal waste management system	2.1. Bulky waste collection sites 2.2. Development of biodegradable waste management infrastructure
3. Protection of landscape and natural resources	3.1. Management of protected areas and their adjustment to visiting 3.2. Investments in upgrading of monitoring system and tools, necessary to carry out environmental monitoring 3.3. Water treatment 3.4. Cleaning of polluted areas 3.5.Arrangement of radioactive waste landfills 3.6. Investments in the Baltic Sea shore treatment

Source: compiled by "BGI Consulting" and "CSIL Milano" according to the information provided by SFMIS, strategic planning documents and the Ministry of Environment of the Republic of Lithuania.

Benefits of environmental projects vary depending on the type of interventions. Environmental sector is generally divided into three sub-sectors:

- Water supply and waste water treatment;
- Waste management;

- Protection of biodiversity, landscape and natural resources

Typical benefit with distinguished sub-sectors and reasoning of detailed benefit (damage) components selection is presented in Table 15. The benefit of specific environmental protection sector of the project should be determined individually, whereas such benefit depends largely on the particular investment and the services offered, they are usually very different in this sector.

Table 16. The arguments for selection of benefit (damage) components

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Increased accessibility of drinking water supply service	Direct impact	This benefit component is distinguished as a major impact for water supply project in the guidelines of European Commission (2008). This component is also distinguished as significant in empirical CBA of foreign water projects. This direct impact matches EU and national strategic guidelines, emphasizing the need to increase the number of the households connected to a centralized drinking water supply. Lithuania has set a target to increase the share of the households connected to a centralized drinking water supply from 81 % in 2012 up to 83 % in 2020. Various projects for new users' connection to a centralized drinking water supply systems are carried out in Lithuania.
2. Increased accessibility of waste water treatment services	Direct impact	This benefit component is distinguished as a major impact for waste water treatment services in the guidelines of European Commission (2008). This component is also distinguished as significant in empirical CBA at foreign sewage projects. This direct impact matches EU and national strategic guidelines, emphasizing the need to increase the number of the households, connected to a centralized sewage system. Lithuania has set a target to increase the share of the households, connected to centralized waste water treatment systems from 79 in 2012 up to 81 % in 2020. Various projects for new users' connection to centralized waste water treatment systems are carried out in Lithuania.
3. Cost savings due to improved storm water infrastructure	Direct impact	The Lithuanian government will finance storm water drainage infrastructure for the term of 2014-2020, as in some cities (such as Vilnius), the existing storm water collection systems are inadequate in heavy rain event. Therefore, it is appropriate to offer benefit component for this type of projects.
4. Reduction of visual pollution, noise, dust, odor	External environmental impacts	Reducing the environmental impact is one of the strategic objectives of both the EU and Lithuania. The reduction of visual pollution, noise, dust and odor in empiric CBA are distinguished in foreign projects for the management of municipal solid waste equipment or closure as significant benefit.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
5. Reduction of carbon dioxide (as a greenhouse gas) emissions 6. Reduction of methane (as greenhouse gas) emissions	External environmental impacts	Emission reduction because of greenhouse gas is now regarded as one of the most important strategic objectives on a global scale, and is highlighted both in EU and Lithuanian strategic documents. The need to reduce CO_2 pollution at European level is stressed in the strategy of Europe 2020. This benefit component in both Lithuanian and foreign waste management projects empirical CBA is distinguished as significant. In particular, this benefit occurs in two cases. First, a reduction of the direct emission from waste management, such as methane (CH_4) isolated from landfills, as well as CO_2 emissions from transport, combustion, and waste management facilities. Secondly, when the life cycle of waste is closed, i.e., the waste is used to produce energy. National Progress program for 2014-2020 also provides a reduction in emissions of municipal waste to landfills from 85 % in 2012 up to 35% in 2020.
7. Surface water quality improvement	Direct impact	Water Framework Directive (WFD) is the most important at European level adopted legislation on water protection. This directive brings very ambitious objectives for water quality and protection, and water resource management is based on the river basin model. Four other EU water legislations, supplementing WFD, such as: the Urban Waste Water Treatment Directive, the Bathing Water Directive, the Nitrates Directive and Drinking Water Directive can be distinguished. Lithuanian National Progress program for 2014-2020 provided that the good condition of water must be increased from 54 % in 2012 up to 72 % in 2020. In view of the urgency of the matter, it is appropriate to evaluate the improved quality of the surface water as potential benefit.
8. increase in value of the recreational area	Direct impact	This is the main benefit, associated with revitalization of natural parks and protected areas

Source: compiled by "BGI Consulting" and "CSIL Milano".

The table in Annex 1 of the sector sets out components of the benefits (damages) that are applicable to specific types of projects.

1.7.3. Calculation Methodology and Application Instructions

1. Increased availability of drinking water supply services

Increased availability of drinking water supply services is one of the main direct impact types of drinking water supply projects. These benefits occur in the case when the new users are connected to the centralized water supply system. Water supply service is a classic case of a natural monopoly, and the prices in this sector are usually distorted. For this reason, the user's willingness to pay for the service is the best way to assess the accounting (i.e., economic) water supply price. The user's willingness to pay can be evaluated using various methods (description of the applied methods is given in Annex 2 of the sector). The EC guidelines for 2008 for consumer willingness to pay for connection to the water supply service offers to evaluate applying the avoided cost approach method, reflecting the disclosed preferences. The avoided cost method sufficiently accurately reflects the value of connection to a centralized water supply system and is widely used in the evaluation of similar investments and, therefore, is offered to Lithuania also.

Calculation methodology and calculated estimate value

According to the avoided cost method, willingness to pay for connection to the water supply service is empirically evaluated applying the best available in the area market price of alternative delivery technologies. Empirically assessing willingness of Lithuanian population to pay for connection to the water supply service is appropriate to rely on avoided consumer costs, incurred by the users' water provision by themselves.

Lithuanian residents themselves can provide water from wells or boreholes. In order to calculate the avoided cost for water provision by them, the data, provided in Table 60 were used[202]. The research methodology that was the basis for setting up the data on unitary wells and boreholes is provided in Annex 3 of the Sector.

Table 17. Data on unitary wells and boreholes (Prices in Litas, 2013)

Costs	Well	Borehole
The average contract price of the works, LTL	4,500.00	5,000.00
The average price of the equipment, LTL	2,000.00	5,000.00
The average annual energy costs, LTL	180.36	180.36
The average annual maintenance costs, LTL	162.50	250.00
The number of lost for average days per year for maintenance	1	1
One day monetary value, LTL *[203]	154.39	154.39
Time series, in years	20	20
The average total costs (over the entire time series), LTL	16,445.00	21,695.00

[202] Because of the shortage of official statistics, data were collected on the basis of publicly available prices and expert opinion.

[203] Monetary value of one for the well / borehole maintenance lost day is equated to the value of the working day. The value applied for Lithuania is calculated according to the average per hour worked Labor costs (Table, published by Lithuanian Statistics Department "M3061113: An employee's average monthly and per hour worked labor costs according to economic activities (CEA 2) and the size of the groups of enterprises"), assuming that the working day consists of 8 hours. Conversion factor that is equal for the simple average of a skilled labor conversion factor (0,973) and unskilled work force conversion factor (0,888) has been applied for calculation of the value.

Costs	Well	Borehole
The average annual operating and maintenance costs, LTL	497.25	584.75
The average annual installation, operation, and maintenance costs, LTL	822.25	1,084.75
The average annual water consumption, m^3	180	180

Source: compiled by "BGI Consulting" and "CSIL Milano" on the basis of published prices and expert opinion.

According to different assumptions, four values of Lithuanian household willingness to pay for connection to a centralized water supply system have been calculated:

- **2.76 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **cost of maintaining the personal well;**
- **3.25 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **personnel borehole operating and maintenance costs**;
- **4.57 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **personnel well installation and maintenance costs**;
- **6.03 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **personnel borehole installation, operation and maintenance costs**.

The first two values of willingness to pay are applicable in the case when the households that are to be connected to centralized water supply network already use private well or borehole. In this case, the contract work and the cost of the equipment have already been experienced and it is impossible to avoid them. The other two values of willingness to pay are applicable in the case when the households that are to be connected to centralized water supply network do not have personal well or borehole. It depends on the case which values should be selected from the recommended value. Therefore, in order to assess the benefit, first of all it is necessary to carry out a careful analysis of the demand.

It should be noted that the willingness to pay values are calculated assuming that the water from the wells and boreholes is suitable for drinking. In the case of wells and boreholes water purification using water treatment facilities, the value of the avoided water treatment costs should be included in the willingness to pay values.

Comparison with other countries. The avoided cost method, reflecting disclosed preferences, is also often used for the analysis in the selected countries (such as Italy, Spain), evaluating human willingness to pay for the planned to connect to centralized water supply system. This method is considered the most appropriate when the contingent evaluation to find out the individual preferences in the case of a specific project cannot be carried out due to time and resource constraints.

Application instructions

Established estimate is applied to the household, so it is suitable to apply to both in the case of individual houses and apartment buildings. The number of households in the case of apartment house can be equated to a number of flats.

In order to evaluate the benefits resulting from the increase in drinking water supply availability, the estimated to Lithuania applied value component benefit values must be multiplied by the number of households, provided to connect to the centralized water supply system. While the information about the connection demand is provided in the expression of the population, the number of population has to be converted into the number of households using the average household size[204]. Simplified calculation model is shown in the Insert 18.

Insert 16. Value of willingness to pay application for the increased availability to water supply services

Suppose 2,300 inhabitants are planned to connect to the centralized water supply system during the project.

All these residents currently use water wells or boreholes. In particular, 30 % of potential new users are using personal water wells, and 70 % are using boreholes. Therefore, all these people are considered as potential new centralized water supply system users.

Since the average household size is 2.17 person, so the number of households expected to connect to the new centralized water supply system is equal to 1,060.

Taking into account the percentage of population using water wells and boreholes, respectively, 30% and 70%, the number of households that use water wells is the 318, and borehole - is 742.

318 are the number of households that are applied value of willingness to pay is 2.76 LTL/m^3. Meanwhile, value of willingness to pay 3.25 LTL / m^3 is applied to 742 households that have boreholes. (Note: This willingness to pay values is applied taking into account that all potential new users currently have private water wells or boreholes. If it does not, other willingness to pay values should apply reflecting not only operation and maintenance, but also the installation costs).

Thus, the total annual value of willingness to pay is:

$$(318 * 180\ m^3 * 2.76\ LTL / m^3) + (742 * 180\ m^3 * 3.25\ LTL / m^3) = 592{,}052.40\ LTL.$$

Source: compiled by BGI Consulting and CSIL Milano.

Estimate update instructions

As willingness to pay meanings, calculated by the avoided cost method, reflect market prices of water well / borehole acquisition and maintenance, they must be periodically updated in order to reflect changes in prices. It is advisable to update benefit component estimate values every year. The avoided cost growth is likely to be close to the inflation. Therefore, benefit component estimate values will be updated increasing 2013 values in proportion to the average consumer price growth (according to the International Monetary Fund published statistics[205]). For the same reason, the same benefit component estimate values will be used during the entire CBA period.

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[204] Table, published by Lithuanian Statistics Department „M3090301: Average size of the household by place of residence".

[205] Source: http://www.imf.org/external/ns/cs.aspx?id=28 (index: Inflation, average consumer prices).

It is recommended to update the values of the benefits component by the expert evaluation method every five years, at the same time updating the value of water consumption in the households per year.

2. Increased accessibility for sewage treatment service

Increased availability of waste water treatment availability is one of the main direct impact types of sewage treatment projects. Waste water treatment, as in the case of water supply service, is a classic case of a natural monopoly, so the prices in this sector are usually distorted. For this reason, the user's willingness to pay for the service is the best way to assess the accounting (i.e., economic) sewage treatment price. The user's willingness to pay can be evaluated using various methods (description of the applied methods is given in Annex 2 of the sector). The EC guidelines for 2008 of investment to the water supply service and waste water treatment, the provided benefit is proposed to evaluate applying the avoided cost approach method, reflecting the disclosed preferences. The avoided cost method sufficiently accurately reflects the value of connection to a centralized waste water treatment system and is widely used in the evaluation of similar investments and, therefore, is offered to Lithuania also.

Calculation methodology and calculated estimate value

According to the avoided cost method, willingness to pay for connection to the waste water treatment service is empirically evaluated applying the best in the area available market price of alternative sewage treatment technologies. Empirically assessing willingness of Lithuanian population to pay for connection to sewage treatment service is appropriate to rely on avoided consumer costs, incurred by the users’ sewage provision by themselves.

Lithuanian residents usually provide waste water treatment themselves, using local sewage with treatment facilities or sewage storage tanks. Data provided in Table 61 was used as the basis in order to calculate the avoided cost of the purchase of equipment, maintenance, and operation[206]. The research methodology that was the basis for setting up the unitary data is provided in Annex 3 of the Sector.

Table 18. Data on unitary local sewage with treatment facilities and sewage storage tanks (Prices in Litas (2013)

Costs	Local sewerage with treatment facilities	Sewage storage tank
Average contract work and equipment price, LTL	15,000.00	3,500.00
Average annual maintenance costs (including periodic residual wastewater disposal / removal), LTL	750.00	3,600.00
The number of lost for average days per year for maintenance	1	1
One day monetary value, LTL [207]	154.39	154.39

[206] Because of the shortage of official statistics, data were collected on the basis of publicly available prices and expert opinion.

[207] It is estimated by analogy with the case of the previous benefit component.

Costs	Local sewerage with treatment facilities	Sewage storage tank
Time series, by years	20	20
Average total costs (over the entire time series), LTL	33,087.80	78,587.80
Average annual maintenance costs, LTL	904.39	3,754.39
Average annual installation and maintenance costs, LTL	1,654.39	3,929.39
Average annual amount of waste water, m^3	180	180

Source: compiled by “BGI Consulting” and “CSIL Milano” on the basis of published prices and expert opinion.

According to different assumptions, four values of Lithuanian household willingness to pay for connection to a centralized water supply system have been calculated:

- **5.02 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **cost of local sewage with treatment maintenance;**
- **20.86 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **cost of sewage storage tank maintenance;**
- **9.19 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **cost of local sewage with treatment facilities equipment and maintenance;**
- **21.83 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **cost of sewage storage tank equipment and maintenance.**

The first two values of willingness to pay are applicable in the case when the households that are to be connected to centralized waste water treatment network already use local sewage with treatment facilities or sewage storage tank. In this case, the contract work and the cost of the equipment have already been experienced and it is impossible to avoid them. The other two values of willingness to pay are applicable in the case when the households that are to be connected to centralized waste water treatment network do not have local sewage with treatment facilities or sewage storage tank. It depends on the case which values should be selected from the recommended value. Therefore, in order to assess the benefit, first of all it is necessary to carry out a careful analysis of the demand.

Comparison with other countries. The avoided cost method, reflecting disclosed preferences, is also often used for the analysis of the selected countries (such as Italy, Spain), evaluating human willingness to pay for the planned to connect to centralized sewerage systems. This method is considered the most appropriate when the contingent evaluation to find out the individual preferences in the case of a specific project cannot be carried out due to time and resource constraints.

Application instructions

The established estimate is applied to the household, so it is suitable to apply to both in the case of individual houses and apartment buildings. The number of households in the case of apartment building can be equated to a number of flats.

In order to evaluate the benefits resulting from the increase in sewage treatment services availability, the estimated to Lithuania applied value component benefit values must be multiplied by the number of households, provided to connect to the centralized sewage treatment services. While the information about the connection demand is provided in the expression of the population, the number of population has to be recalculated into the number of households using the average household size[208].

Estimate update instructions

As willingness to pay meanings are calculated by the avoided cost method, reflects market prices of local sewage with treatment facilities or sewage storage tank acquisition and maintenance, they must be periodically updated in order to reflect changes in prices. It is advisable to update benefit component estimate values every one year. The avoided cost growth is likely to be close to the inflation. Therefore, benefit component estimate values will be updated increasing 2013 values in proportion to the average consumer price growth (according to the International Monetary Fund published statistics[209]). For the same reason, the same benefit component estimate values will be used during the entire CBA period.

It is recommended to update the values of the benefits component by the expert evaluation method every five years at the same time updating the value of waste water sewage in the households over the year.

33. Cost savings due to improved storm water infrastructure

Time cost economy is the biggest improved storm water infrastructure benefit. Improved rainwater collection system helps avoiding transport jam because of flooded streets after heavy rain, so in this case time is saved.

This benefit component and its estimates are the same as those described in the section for the transport sector (see: Component "1. Time savings of freight and passenger transport"):

- applicable time value for business passengers is equal to **29.33 LTL/ hour** according to the prices of 2013;
- applicable time value for non-business passengers is equal to **11.73 LTL/ hour** according to the prices of 2013;
- applicable value for freight transport is equal to **11.35 LTL/ hour** for one-borne cargo ton according to the prices of 2013.

Application of component and estimate for the environmental sector

Benefit component estimate application instructions are analogous to the case for the transport sector. Benefit component estimate should be applied to passengers (or tons of freight in transport), rather than for vehicles. If available information on traffic includes only the number of vehicles, this number should be converted into the number of passengers (or cargo tons), using the average number of persons, traveling in

[208] The table, published by Lithuanian Statistics Department „M3090301: Average size of the household by place of residence".
[209] Source: http://www.imf.org/external/ns/cs.aspx?id=28 (index: Inflation, average consumer prices).

the vehicle, or the average weight of shipping goods, which are specified in the chapter for transport sector.

Simplified calculation model is shown further.

Insert 17. Application of estimate for travel time savings

The project includes reconstruction of storm water infrastructure, which will improve storm water collection in two streets (both of 5 km length).

The annual average daily traffic before the implementation of the project amounted to 5,000 vehicles per day. Traffic flow is not expected to increase after the intervention, but improved storm water infrastructure during heavy rain makes travel faster than was previously possible, creating travel time savings for road users.

The time value of persons traveling by standard vehicles (in this example there is not differ between passenger cars and heavy-duty vehicles for the sake of simplicity, it is assumed that all trips are carried out for business) is equivalent to 29.33 LTL/ hr., when the average vehicle speed during heavy rain is 20 km / h. Thus, the time consumption per kilometer is:

29.33/20 = 1.47 LTL/km.

If vehicle speed during heavy rain will be 50 km / hr. after the improving rainwater collection system, the time cost per kilometer is reduced:

29.33 / 50 = 0.59 LTL/km.

Therefore, travel time savings value is:

1.47 - 0.59 = 0.88 LTL/km.

Taking into account the overall length of analyzed streets (10 km), the overall project determined travel time savings value is:

0.88 LTL/km* 10 km = 8.8 LTL for one passenger.

This value must be adapted to the estimated traffic flow, constituting 5,000 vehicles per day. Vehicles employment rate is equal to 1.2 passengers per car, traffic is equal to 6,000 passengers per day.

Assuming that the average heavy rain annual duration is 20 days, annual benefits of the project related to the travel time savings for road users, would be:

8.8 LTL * 6,000 passengers per day * 20 days= 1,056,000 LTL per year.

Source: compiled by “BGI Consulting” and “CSIL Milano”.

4. Reduction of visual pollution, noise, dust, and odor

Waste treatment facilities near the landfill usually cause adverse external effects, such as: visual pollution, noise, and odors. These external effects can be reduced because of some projects. For example, this can be done after the closure of uncontrolled landfill, or after the construction of a modern landfill with odor control measures.

Calculation methodology and calculated estimate value

Visual pollution is the impact of pollution, withdrawing the opportunity to enjoy the view. Noise pollution, in turn, is defined as unwanted (in terms of decibel) sound or sounds of various durations and intensity, and other characteristics, which result in human psychiatric disorders. Meanwhile, the smell pollution can cause irritation in outdoor activities, or limitation of opportunities to open windows. Even if the smell pollution does not have long-term health effects, it can cause a headache, nausea, and even vomiting.

The decrease of the negative environmental impacts of all three elements is evaluated in general; the projects, providing construction of new and reliable waste treatment facilities, or upgrading the existing, are usually intended to reduce all three aspects of the unpleasant effects.

There are several ways to give the monetary value to unpleasant environmental impact of the projects. One of them is to rely by disclosed preferences (real estate market value). The unpleasant effect influence on waste management infrastructures, especially of landfills on the (lower) property prices is widely described in literature. The study of Brisson and Pearce „Literature Survey on hedonic property prices studies of landfill disamenities" is one of such examples (1998). Thee method of expressed preferences is the other possible method, which is based on the willingness to accept compensation or to pay for reduce of the visual, noise, and odor pollution.

The assessment of visual pollution, noise and odor reduction is proposed to carry out in accordance with the proposed preferences method, in particular by the hedonic price method, which is often used to evaluate a similar investment. The basic precondition of this approach is that if uncontrolled landfill nearness determines property values decrease, the landfill closure should make the opposite effect, and increase the property value.

First, it is important to determine the maximum benefit limit. Affected areas can be identified by the characteristics of urban infrastructure of the landfill and behind it. One kilometer distance from the outer limit of the landfill is considered to be the preferred limit, but in the case of specific project, the other distance may be chosen, if the promoter can justify such arguments for selection. Second, it is important to learn real estate and the market value in landfill affected area according to the real estate registry. Third, the increase in real estate value should be determined by reference to a similar, but by the proximity of the landfill untreated area of real estate value indicated in the real estate register. Generally, the increase in value is ranging from 3 to 10 % of the property value (the group of experts identified this range on the basis of individual experts CBA application experience and expert group consensus). Finally, in order to obtain the value of the benefit, the following formula is applied:

$$B = \sum_i N_i * V_i * \Delta_i\% ,$$

where i means the type of the property, N means the amount of assets, V is the average value of the property, Δ% is the percentage of property price rise because of the project implementation.

Result (B) expresses the estimated property value increase due to the project implementation, contributing to negative waste infrastructure influence of environmental impact assessment.

Comparison with other countries. The analysis of the experience of foreign countries (Bulgaria and Romania) showed that the same methodology is used in the other countries also. Specifically, the sectoral guidelines of the analyzed countries offer to equate real estate value increase, due to the closure of landfill, to 5 % of real estate value. However, it is advisable to check this value using the sensitivity and risk analysis.

Application instructions

In practice, the change of real estate price because of the closure of the landfill is assessed in four steps:

1. *Identification:* the amount and type of real estate in landfill affected area is identified.
2. *Calculation of the value of real estate:* each type of real estate value is identified according data of real estate registry.
3. *Value increase calculation:* percentage increase in real estate value (because of the project implementation) is determined according to a similar, but by the proximity of the landfill untreated area of real estate value, indicated in the real estate register.
4. *Evaluation:* applied equation B = $\sum_i N_{i,} * V_i * \Delta\%$, where *i* means real estate type, N_i is the amount of real estate of *i* type located near the landfill, V_i is the average real estate value of *i* type, Δ% is real estate price increase because of the implementation of the project.

Estimate update instructions

Value increase percentage (Δ%) is calculated separately for each project. However, applying the provided calculation mechanism it is recommended to increase the real estate value for CBA-term future year according to real GDP per capita growth. Future values may be calculated on the basis of real GDP per capita forecast, published by the International Monetary Fund.

5. Reduction of carbon dioxide (as a greenhouse gas) emissions

The benefit of greenhouse gas emissions reduction occurs in two cases. First, after the reduction of direct waste management activities caused emissions, such as exuding methane (CH_4) from landfills, as well as CO_2 emission from transport, burning, and waste treatment facilities. Secondly, when the life cycle of waste is close, i.e. the waste is used to produce energy. Energy production from waste allows avoiding emission that would be created using other energy sources. Waste management projects help to reduce these greenhouse gas emissions: first, carbon dioxide (CO_2) and, secondly, methane (CH_4). Benefit component reflecting methane (as greenhouse gas) emissions decrease is analyzed in the next section.

In the case of CO_2 emissions during burning of biofuel, CO_2 emitted from biogenic sources and fossil should be separated. According to Wenzel and Hauschild[210]:

"*From the perspective of the life-cycle, only emission, characterized by a pure CO_2 input to [emissions from the landfill to atmosphere] assessment must be included. Emitted carbon dioxide from non-renewable sources (fossil carbon compounds) increases the general CO_2 amount in atmosphere, while CO_2 emissions from the renewable sources (biogenic carbon compounds) can be regarded as a neutral issue [...].Plastics*

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[210] Wenzel H., Hauschild M. and Alting L., 1997, Environmental Assessment of Products, Volume 1: Methodology, tools and case studies in product development, Kluwer Academic Publishers.

and other petroleum origin waste are classified as non-renewable sources and all the biodegradable organic waste, such as food or garden waste are renewable".

According to this statement, not all CO_2 amount from emitted from biogas combustion process, but only arising from non-renewable materials should be included to the analysis.

In order to reflect the greenhouse gas (GHG) impact to economic analysis of waste management projects, market price is one of possible ways to assess the cost of emission allowances obtained by operator. Based on this approach, economic value is reflected by reduced cost of allowance which depended on reduced emission. However, due to the distortions in European trade system, the price of allowances cannot be considered reliable expression of emission economic costs.

Therefore, the reduction of GHG emissions, created by Lithuanian waste management projects, is proposed to evaluate by multiplying quantities of emission (tons of CO_2 equivalents per year) of assessment of the project (in addition, compared to a scenario without the project) by point value of economic costs. The proposed method is identical to the transport sector projects, proposed for GHG emission reduction valuation method. I.e., carbon dioxide (as a greenhouse gas) emissions reduction component and its estimates are the same as those, described in the transport chapter.

Application of component and estimate for the environmental sector

Instructions of application of benefit component estimate are analogous to the sector in transport Chapter. Quantity of emission of carbon dioxide (CO_2) would have to be multiplied by point value of CO_2 emission costs estimate. In such case impact monetary value is obtained.

Generally, the impact on quantity of separate gases is presented in final report of environmental impact assessment.

6. Reduction of methane (as greenhouse gas) emissions

In addition, methane (CH_4) is also attributed to greenhouse gases as carbon dioxide (CO_2). In order to reflect the methane (CH_4) emissions costs, CH_4 emissions in tons must be recalculated into CO_2 equivalents. Global Warming Potential, GWP factor [211], which is arranged with the factor, specified in the Kyoto Protocol and the Intergovernmental Panel on Climate Change Second Assessment Report. The obtained amount in CO_2 equivalents is multiplied by point value of CO_2 emission economic costs.

The last assessments of Intergovernmental Panel on climate change commission corresponding CH_4 global warming potential are presented in the table below.

[211] Factor reflects CO_2 amount that has the same global warming potential as one CH_4 point, measuring over a certain period of time.

Table 19. CO_2 and CH_4 global warming potential

GHG	Time series		
	20 years	100 years	500 years
Carbon dioxide (CO_2)	1	1	1
Methane (CH_4)	72	25	7.6

Source: compiled by BGI Consulting and CSIL Milano on „Forster, P., Ramaswamy, V., Artaxo, P., Berntsen, T., Betts, R., Fahey, D.W., Haywood, J., Lean, J., Lowe, D.C., Myhre, G., Nganga, J., Prinn, R., Raga, G., M., S., Van Dorland, R., 2007. Changes in Atmospheric Constituents and in Radiative Forcing. In: S. Solomon et al. (Editors), Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K."

According to the data in Table 19, the applicable rate of methane (CH_4) emissions (tons) conversion to carbon dioxide (CO_2) equivalent is equal to 25.

Application methodology

Methane (as greenhouse gas) emission reductions benefit is estimated in the following steps:

1. *Evaluation of quantity*. The amount of CH_4 emission points (for waste management unit amounts) that is generated by the project and counterfactual case (i.e., the basic scenario) must be determined. On this basis the decrease or increase in emission amounts because of the implementation of the project are determined. Generally, the influence on the individual gases is provided in the project's environmental impact assessment report.
2. *Recalculation*: CH_4 emission in tons must be converted into CO_2 equivalents.
3. *Evaluation*. CH_4 amount of emission (in CO_2 equivalents) must be multiplied by the cost per unit estimate of the CO_2 emission. In this way, the impact of monetary value is obtained.

7. The improvement of the quality of surface water

Various projects can lead to surface water quality improvement [212] - benefit that is associated with a decrease in the quantity of pollutants and / or increase in dissolved oxygen level. Typically, such benefits result from the project, providing sewage treatment plant construction. During implementation of such projects, effluents in order to avoid dangerous pollutants are cleaned before being discharged into surface waters. The projects for sludge from water removal and other water cleaning may also develop such benefits. In addition, it can also be find in the projects, related to storm water[213] management infrastructure, i.e., bio-retention systems, infiltration or retention reservoirs.

Calculation methodology and calculated estimate value

Analyzing benefits can be assessed in determining people's willingness to pay for improved water quality in water bodies. Various methods are applied in order to find out people's preferences, but the advantage is given to the contingent assessment. However, the latter method is often expensive and time-consuming. Therefore it is possible to rely on alternative methodologies (wider described in Annex 2 of the Sector).

Various methodologies can be applied depending on the evaluated project. For example, the assessment of the willingness to pay for the project, intended for water quality improvement for fishing, differs from the assessment of the willingness to pay for improving of water quality for bathing without the consumer value. In other words, used (or unused) values of surface water should first be aware in order to choose the best method of assessment. Use (or unused) values of natural resources are described more detail in Annex 2 of the Sector.

Two willingness to pay estimates were calculated for Lithuania for such benefits assessment. The first estimate reflects water quality improvement use value, in particular, bathing value. This benefit occurs when the project removes the prohibition on bathing. The second estimate reflects the unuse value of the improvement of the water (for the implementation of pollution prevention). Both estimates are based on provided values in the ECOTEC study[214].

- *Willingness to pay for bathing water quality improvement*

According to ECOTEC calculations, the willingness to pay for such benefits in Lithuania by prices of 1999 is equal on average to **68.17 LTL per person per yea**r. The applicable value for 2013 was calculated increasing

[212] The quality of water include chemical, physical and biological characteristics of water.

[213] Storm water is the water, produced during the rainfall. Not sinking to the soil storm water becomes not sunk excess water draining directly into surface waters, or is diverted to the sewer pipes, after that eventually falling into surface waters. Rainwater, especially in urban areas is characterized by high levels of pollutants, so after such water directly pass to the surface water, the deterioration risk of water quality in surface waters occurs.

[214] ECOTEC, *The Benefit of Compliance with the Environmental Acquis for the Candidate Countries*, 2001. The purpose of this study is to investigate and assess the environmental, economic and social benefits which could result after complete implementation of the EU laws governing the protection of the environment in the candidate countries. The attribution for monetary value of benefit is also provided in this study.

the value of the 1999 proportionally of nominal GDP per capita growth[215] (according to the International Monetary Fund published statistics) and is equal to **219 LTL per person per year**.

- *Willingness to pay for improvement of unused (existential) value having water quality*

ECOTEC determined two willingness to pay estimates for such benefits for Lithuania, i.e.:

- the willingness to pay for the improvement of the river water quality from "bad" to " quite good" and is **0.0034 LTL per household per kilometer per year** in 1999 prices; In 2013 applicable value was calculated increasing the value of 1999 proportionally to the growth of nominal GDP per capita and is equal to **0.011 per household per kilometer per year**.
- The willingness to pay for river water quality improvement from "quite good" to "good" and is **0.0094 LTL per household per kilometer per year** in 1999 prices;. The value applicable for 2013 was calculated by increasing 1999 value proportionally to nominal GDP per capita growth and is equal to **0.0244 LTL per household per kilometer per year**.

Comparison with other countries. The experience analysis of foreign countries (Bulgaria and Romania) revealed that other countries also quote on the values of the ECOTEC calculating willingness to pay for surface water quality improvement.

Application instructions

If the information about the people affected by the project is available only at the level of households, the number of households by the average household size[216] should be recalculated into the number of persons. Analogous recalculation is applied in the reverse situation (when only the number of persons, affected by the project is known, but the benefit component estimate is applied to households).

Precaution to avoid double-calculating trying to determine the number of people affected by the project is necessary. Willingness to pay for bathing water quality improvement should be multiplied by the number of persons potentially eligible to use water for the purposes of bathing. Therefore, the demand of these goods should be treated carefully. Meanwhile, the willingness to pay for unused value water quality improvement should be multiplied by total Lithuanian population, because this value reflects the existential value, i.e., people willingness to pay just for maintenance of good water quality.

Instructions for update of estimate

It is recommended to renew the benefit of component estimate value every year. The applicable value for the first year CBA is calculated by increasing the significance of 2013 proportionally to the nominal GDP per capita growth (according to the International Monetary Fund published statistics). CBA period applicable to future years is calculated by increasing the value of the first analysis of the CBA in proportion to the value of real GDP per capita growth (based on International Monetary Fund projections).

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[215] In the period of 2009-2013, the nominal per capita GDP has increased by 3.21.

[216] According to data of Lithuanian Department of Statistics, the average size of household in Lithuania in 2012 was 2.17 person. See: The table, published „M3090301: Average size of the household by place of residence“.

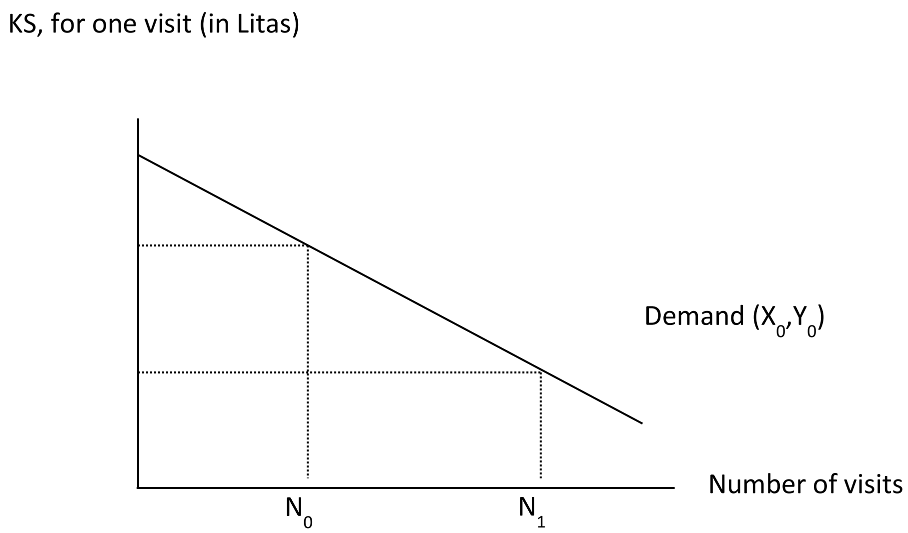
8. The increase in value of the recreational area

The increase in value of the recreational area is considered to be a major benefit, concerned with the regeneration of natural recreational places to visit, such as: natural parks and protected areas. Evaluation of this benefit means rating of a specific natural area use for recreational purposes, regardless of whether access to the territory is paid or not. The entrance to natural recreational places of interest is often free. In order to assign monetary value for this type of places of interest, it is often based on value of goods or services, complementary used with free pleasure, such as e.g., travel value.

Calculation methodology and calculated estimate value

The standard value calculation methodology of natural recreational place to visit is considered travel cost method. The latter is based on the data on the cost of travel to the recreational places to visit. The demand curve can be drawn according to the data on generalized travel costs to natural recreational places of interest and the number of persons, traveling to those places.

The demand is necessary travel expenses (KS) in order to reach a certain territory, place to visit attributes, and its substitutes vector (X), and the visitor[217] or zone, where the visitors are coming from[218], function of characteristics vector (Y) (as shown in Figure below). It is worth mentioning that the trip cost includes not only the actual monetary travel costs, but also the travel time value, and other costs, concerned with the visit, such as accommodation costs.



Picture 4. The demand curve of the travel to a certain territory

Source: compiled by "BGI Consulting" and "CSIL Milano".

[217] In the case of individual travel cost methodology

[218] In case of time series travel cost methodology

Having drawn a demand curve, the proposal to improve certain place to visit attribute from X_0 to X_1 consequence that should reflect in the demand curve shift up, can be evaluated.

The example of how to apply the zonal travel cost methodology is provided at benefit component estimate application instructions. The term "zonal" refers to the level of analysis, where it is focused on zones from which visitors come to the places of interest.

Comparison with other countries. The analysis of the experience of foreign countries (such as Italy, Spain) revealed that other countries, calculating the recreational value of natural places to visit, also quote travel cost methodology.

Application instructions

The following is the example of the application of time series travel cost methodology. This data are presented only for the illustrative purposes.

Suppose, the nature park is analyzed, to which visitors are arriving by car from four zones:

- A zone, the distance from the park is 25 km (journey takes on average ½ hour)
- B zone, the distance from the park is 50 km (journey takes on average 1 hour),
- C zone, the distance from the park is 80 km (journey takes on average 2 hours),
- D zone, the distance from the park is 120 km (journey takes on average 3 hours).

Entrance fee is the same for all visitors and is 5 Litas. The following annual number of visits from each zone is:

- from A zone on average 15,000 visits,
- from B zone on average 10,000 visits,
- from C zone on average 6,000 visits,
- from D zone on average 5,000 visits.

The source data of the example are summarized in Table 63.

Table 20. The analysis of source data, used in the example

Zone	Travel time (hours)	Travel distance (km)	Entrance fee (Lt)	Numer of visits (per year)
A	1/2	25	5	15,000
B	1	60	5	10,000
C	2	120	5	6,000
D	4	250	5	5,000

Source: compiled by "BGI Consulting" and "CSIL Milano".

In order to evaluate the value (V) of places to visit, the following equation is applied:

$$V = \sum_{z} (E+(T_z * TM) + TP+OtE) * N_z$$

where:

- S is actual monetary travel cost per visitor (LTL); for the journeys by car, S $=A_z * VOC_L$, where A is the distance (km), and VOC_L is per visitor vehicle operating costs (LTL / km),
- T is travel time (hr.)
- TM is time value (LTL/hr.),
- TP is the entrance to the point of interest (ticket) prices (LTL),
- N is the average number of visitors per year,
- OtE is the average of "other expenses", incurred by the visitor, traveling to recreational point of interest. Typical examples of such costs can be accommodation and catering costs. Nevertheless, strict inclusion rule should be included in order to incorporate these costs. There should be taken into account only to "other costs", directly related to the visit in the places of interest,
- z means zone (A, B, C, D in the example).

The actual monetary travel expenses (E) include the amount of money that is actually spent by a visitor to reach Natural Park. Based on the given model hypotheses, all visitors come to the park by car, so E in this case should include one visitor per vehicle operating costs. But in general, considering that monetary travel expenses (E) and travel time (T) for one visitor differs depending on the means of transport, initially it is advisable to divide all from each zone arriving visitors according means of transport they use (i.e., cars, buses, trains). Then, actual monetary travel costs and travel time shall be calculated for each means of transport.

As it is indicated in the chapter for transport sector (see: Component 1. Freight and passenger time savings), **the time value of non-business passengers calculating in prices of 2013 is equal to 11.73 LTL/ hour.** Meanwhile, car operating costs value in Lithuania (VOC) in prices of 2013 is 0.83 LTL / km (with charges).[219]. However, in order to complete the above formula, vehicle operating costs must be divided by the average number of people traveling by car, which in Lithuania are 1.2 passengers in the car[220]. However, the promoter of the project after performing the demand analysis and having examined peculiarities of potential visitors, traveling by car, may establish the value of more than 1.2 passengers in the vehicle, the number of people traveling by car (for example, 2, 3, or another value).

The results of analyzed samples are presented below in the last column of the Table[221]. First, travel costs incurred by travelers, arriving from each zone by specific vehicle are calculated (in the given sample, all visitors are arriving by car). Then the total travel costs of the travelers going from each zone are calculated, and finally, the total annual cost of place to visit is calculated.

Table 21. Calculation sample of Yearly Value of places to visit

Zone, z	Travel time (hrs.), T	Time value of (Lt / hr.),TM	Travel Distance (km), A	VOC value / car km	Entrance fee (LTL), BK	Number of visits over the year, N_z	Zone value (in Litas)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) = ((2)*(3)+(4)*(5)/ 1,2 + (6))*7
A	1/2	11.73	25	0.83	5	15,000	422,350.00
B	1	11.73	60	0.83	5	10,000	582,300.00
C	2	11.73	120	0.83	5	6,000	668,760.00
D	4	11.73	250	0.83	5	5,000	1,124,183.33
Annual value of places to visit							**2,797,593.33**

Source: compiled by "BGI Consulting" and "CSIL Milano".

In case of multi-purpose travel, i.e., when it is traveling for various purposes, it is not always possible properly allocate travel costs for every purpose. Therefore, in order to avoid double-counting of the benefits, project analyst must clearly identify the assumptions that are based attributing share of the cost for the particular purpose.

Estimate update instructions

Travel time value update instructions are given at the section for transport sector.

[219] According to the data from Public enterprise Road and transport research institute; this value is the before indirect taxes, whereas in this case VOC reflects the willingness to pay

[220] According to the data from public enterprise Road and transport research institute.

[221] It is assumed that the "other costs" are equal to zero.

VOC upgrade instructions are analogous to those at the section for transport sector provided instructions for updating VOC.

1.7.4. The Table of Socio-Economic Impact Estimate of Environmental Protection Sector

In summary, determined socio-economic impact estimates are presented in tabular form, set out in Terms of Reference (Table 65). Table of indicators according to requirements of terms of reference must be associated with conversion factors, established by a service provider in order to ensure that there will be no benefits and damage double-counting in calculation. However, none of the appointed estimate is related to the costs, applicable determined conversion factors, so, there is no risk of benefits and damage double-counting.

Table 22. Socio-economic impact estimates determined for environmental sector

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload (table of strong, reliable and significant ratings (at least three)	Quantitative expression, LTL
Environmental protection	N/a	N/a	1. Increased drinking water supply service availability	Values of Lithuanian household willingness to pay for connection to centralized water supply system (in prices of 2013.): • **2.76 LTL/m³** is the unit value of household willingness to pay, calculated according to the avoided **cost of maintaining the personal well;** • **3.25 LTL/m³** is the unit value of household willingness to pay, calculated according to the avoided **personnel borehole operating and maintenance costs**; • **4.57 LTL/m³** is the unit value of household willingness to pay, calculated according to the avoided **personnel well installation and maintenance costs**; • **6.03 LTL/m³** is the unit value of household willingness to pay, calculated according to the avoided **personnel**

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload (table of strong, reliable and significant ratings (at least three)	Quantitative expression, LTL
				borehole installation, operation and maintenance costs.
Environmental protection	N/a	N/a	2. Increased availability of waste water treatment services	Values of Lithuanian household willingness to pay for connection to a centralized wastewater treatment system (in prices of 2013): • **5.02 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **cost of local sewage with treatment maintenance;** • **20.86 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **cost of sewage storage tank maintenance;** • **9.19 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **cost of local sewage with treatment facilities equipment and maintenance;** • **21.83 LTL/m^3** is the unit value of household willingness to pay, calculated according to the avoided **cost of sewage storage tank equipment and maintenance.**
Environmental protection	N/a	N/a	3. Cost savings due to improved storm water infrastructure	Time value (in prices of 2013): • for business passengers is equal to **29.33 LTL/ hour**; • for non-business passengers is equal to **11.73 LTL/ hour**; • for freight transport is equal to **11.35 LTL/ hour** for one-borne cargo ton.
Environment	N/a	N/a	4. Visual pollution, noise, dust,	Generally, the increase in value is ranging from 3 to 10 % of the

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload (table of strong, reliable and significant ratings (at least three)</th><th>Quantitative expression, LTL</th></tr>
<tr><td>al protection</td><td></td><td></td><td>odor reduction (expressed in terms of real estate value increase)</td><td>property value. In the specific case, the increase in real estate value should be determined by reference to a similar, but by the proximity of the landfill untreated area of real estate value, indicated in the real estate register</td></tr>
<tr><td>Environmental protection</td><td>N/a</td><td>N/a</td><td>5. Carbon dioxide (as a greenhouse gas) emission reduction</td><td>Recommended Economic value of carbon dioxide (CO_2) emission (in Litas per ton of CO_2)
<table>
<tr><th rowspan="2">Year of application</th><th colspan="3">Central value</th></tr>
<tr><th>Lower value</th><th>Central value</th><th>Upper value</th></tr>
<tr><td>2010–2019</td><td>28</td><td>86</td><td>169</td></tr>
<tr><td>2020–2029</td><td>59</td><td>138</td><td>242</td></tr>
<tr><td>2030–2039</td><td>76</td><td>190</td><td>345</td></tr>
<tr><td>2040–2049</td><td>76</td><td>242</td><td>466</td></tr>
<tr><td>≥2050</td><td>69</td><td>293</td><td>622</td></tr>
</table></td></tr>
<tr><td>Environmental protection</td><td>N/a</td><td>N/a</td><td>6. Reduction of methane (as greenhouse gas) emission</td><td>Applied ratio of methane (CH_4) emission (tons) conversion to carbon dioxide (CO_2) is 25.</td></tr>
<tr><td>Environmental protection</td><td>N/a</td><td>N/a</td><td>7. Improvement of surface water quality</td><td>Willingness to pay for bathing water quality improvement is 219 LTL per person per year calculating in prices of 2013.
Consumer willingness to pay for unused (existential) water quality improvement:
for river water quality improvement from "bad" to " quite good " is 0.011 LTL per household per kilometer per year calculating in prices of 2013;</td></tr>
</table>

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload (table of strong, reliable and significant ratings (at least three)	Quantitative expression, LTL
				• for river water quality improvement from "quite good" to "good" is **0.0302 LTL per household per kilometer per year** calculating in prices of 2013.
Environmental protection	N/a	N/a	8. The increase in area recreational value (reflected in travel costs)	• the time value of non-business passengers calculating in prices of 2013 is equal to 11.73 LTL/ hour. • VOC value for cars applying the prices of 2013 is 0.83 LTL / km (with charges); • the average number of people, traveling by car is 1.2 passengers in the car (or the project developer set number of persons traveling by car).

Notes:

* Table of indicators must be associated with conversion factors, established by a service provider in order to ensure that there will be no benefits and damage double-counting in calculation.

1.7.5. Annexes (Environmental Sector)

Annex 1. Benefit (damage) components, applied to different types of projects

Project type	Applied benefit (damage) components (*)
1. Renovation and development of water supply and waste water treatment systems	1. Increased availability of drinking water supply service 2. Increased availability of waste water treatment services 3. Cost savings due to improved storm water infrastructure
2. Development of municipal waste management system	4. Visual pollution, noise, dust, and odor reduction 5. Carbon dioxide (as a greenhouse gas) emission reduction 6. Methane (as greenhouse gas) emission reduction
3. Protection of landscape and natural resources	7. Surface water quality improvement 8. The increase in value of the recreational area

Source: compiled by "BGI Consulting" and "CSIL Milano".

** Note: only a part of the listed components can be appropriate for a specific project*

Annex 2. Total economic value

Total economic value (TEV) is a concept of social value, obtained from the natural resource, infrastructure, or service possession, compared with their lack of possession. Initially TEV concept was used in the context of the environmental sector, assessing total with the project or implemented by policies external and indirect impact[222].

Total economic value of the project or implemented policy direction is expressed by net amount of both positive and negative sense of welfare changes, determined by changes in the quality of the environment. It is worth mentioning that the TEV does not assess the quality of the environment as such, but it reflects preferences provided by the people.

TEV is the sum of two components: use and non-use (environmental) value of the goods. Use value is associated with consumption of actual or potential certain goods / service (respectively "actual" and "optional" use value). Use value includes the benefits arising from physical use of natural resources for recreational activities (e.g., fishing) or production activities (e.g., agriculture). Non-used value means the willingness to pay for preservation of environmental goodies, even if the latter in fact or potentially is not used. In other words, non-used value reflects individuals' benefits from directly non-used environmental goods / resources. For example, some people are interested in coral reef conservation; even if they do not go there. Non-used value is classified into:

- existential value, reflecting the willingness to pay for conservation of non-tradable goods, which are not used in fact or potentially;
- altruistic value, which can occur when individuals are interested in non-tradable goods would be accessible to other people of the same generation;
- heritable value that can occur when individuals are interested that non-tradable goods would be available for future generations.

The easiest way to calculate the economic value is to rely on the actual market (if such exists) price. For example, when the project for the construction of sewage treatment plants increases the amount of catches, the additional catch value can be observed in the fish market. When such market does not exist, the price is estimated using non-market valuation procedures, which are based on an individual's willingness to pay for the non-tradable goods / service.

In order to give a monetary value to non-market good changes, the following three methods are applied:

- **Expressed, preferences method:** willingness to pay is directly assessed through surveys, asking respondents to indicate the maximum amount of money that they are willing to pay for a hypothetical goody / service. Contingent evaluation is the most commonly used method to ascertain personal preferences expressed by the monetary value. Respondents are asked to

[222] See: e.g., Daily G. (1997) Nature's Services. Washington (DC): Island Press; Turner, R.K. (1999) The place of economic values in environmental valuation. Valuing environmental preferences: theory and practice of the contingent valuation method in the US, EU, and developing countries (eds I.J. Bateman & K.G. Willis). Oxford University Press, Oxford.

provide (say), their willingness to pay, depending on the specific hypothetical scenario and description of services. However, this method can be very expensive and costly.

- **Disclosed preference method**: it is assumed that non-market non-tradable goods / services assessment is based on the other cost of products / services, participating in the market. In other words, this method is based on an implied willingness to pay. Disclosed preferences method includes various methodologies: travel costs, hedonic price, avoided costs, avoidance or defensive behavior, and illness costs.
- **Benefit transfer method**: this means economic value adjustment of certain non-tradable goods / services provided in the literature, evaluating similar goods / services for which the economic value is not assigned and the contingent assessment cannot be carried out. In other words, non-market goods value is determined on the basis of the same goods which have already been assessed in another context, specifically for the (ad hoc) contingent valuation or by disclosed preference method unit values. In application process it is important to take into account technical, socio-economic, geographical and temporal characteristics of the assessed goods / services.

Annex 3. Description of main regulations of calculation of benefit (damage) component „1. Increased drinking water supply services availability“ and „2. Increased sewage treatment services availability“ estimate

Calculation of part at the environmental sector provided the benefits (damage) components estimate are based on the analysis of observed market prices. E.g., benefits (damage) components Increased drinking water supply services availability“ and „Increased sewage treatment services availability”. Calculation methodology of these components is based on point of view of the consumer's willingness to pay for the service. The service provider's team of experts proposed a willingness to pay to equate because of the project avoided water supply and sewerage installation and operating costs. I.e., Lithuanian population willingness to pay for connection to the water supply or sewage disposal services are treated as consumers avoided costs incurred by consumers providing water or installing sewage disposal system themselves. In order to calculate the cost of the consumer, first you need to identify the most widespread method of the provision of individual services among the population of Lithuania. Having identified the method of providing the service, it is necessary to set the minimal consumption parameters corresponding capacity of technical equipment. According to typical service provision means and requirements for technical capacity of the equipment, the key components of equipment, construction works and maintenance components must be determined. Having determined the equipment, contract work and operating components and their technical characteristics, the survey of analyzed equipment supplying and contract work performing operators or the market price monitoring on publicly available sources (Internet portals of legal entities, where bids, ads, etc. are placed) can be performed. It is recommended to refer to at least three different types of pricing sources on information about equipment and construction works.

During the preparation of the methodology, were defined the key parameters, required for the calculation of the benefit (damage) component **“Drinking water supply service availability" estimate value:**

1. The most common central water supply technical parameters corresponding individual service means between Lithuanian population is:
    a. Shaft wells for drinking water extraction;
    b. Deep (artesian) wells for drinking water extraction;
2. The capacity of technical equipment, corresponding minimum consumption parameters, is serving for 180m^3 of drinking water per year, based on average annual household water consumption in Lithuania
3. The main components of means of the individual water supply equipment, construction works and maintenance of components are:
    a. Shaft well for drinking water extraction:
        i. Contract works (excavation, concrete rings (or analog), hood, and other work);
        ii. Equipment (water pump, compressor, pipes / tubes, installation);

iii. Operating costs (maintenance (work), energy (electricity)).

b. Deep wells for drinking water extraction;

i. Contract works (excavation, construction materials and equipment, other work);

ii. Equipment (water pump, compressor, pipes / tubes, installation);

iii. Operating costs (maintenance (work), energy (electricity)).

4. Time series with calculated operating expenses are 20 years;

Benefit (damage) component "The availability of drinking water supply services" estimates value is recommended to convert on the basis of set out above main parameters. The individual, carrying out calculations, can review market prices both at the level of the individual parameters as well as providing request of the entire installation price for these providers. In the first case (shaft wells) more rational argument for selection is to provide price monitoring in accordance with the individual components, as this service in the market as a whole is not widespread. Also, at given time providing conversion of operating costs one should quote on other benefits (damage) components (i.e., value of the working day) and the corresponding conversion factor.

The following data on unitary wells and boreholes were determined according to the specified parameters and steps for 2013:

Table 1. Data on unitary wells and boreholes (Prices in Litas, 2013)

Costs	Well	Borehole
The average contract price of the works, LTL	4,500.00	5,000.00
The average price of the equipment, LTL	2,000.00	5,000.00
The average annual energy costs, LTL	180.36	180.36
The average annual maintenance costs, LTL	162.50	250.00
The number of for average lost days per year for maintenance	1	1
One day monetary value, LTL[223]	154.39	154.39
The time series, in years	20	20
The average total costs (over the entire time series), LTL	16,445.00	21,695.00
The average annual operating and maintenance	497.25	584.75

[223]One day lost for the well / borehole maintenance monetary value is equated to the value of the working day. The applied for Lithuania value is calculated according to the average per hour worked Labor costs (the Table, published by Lithuanian Statistics Department "M3061113: An employee's average monthly and per hour labor costs according to economic activities (CEA 2) and enterprise size groups), assuming that the work day consists of 8 hours. Conversion factor, equal to skilled labor force conversion factor (0.973) and unskilled work force conversion factor (0.888) simple average was applied for calculation of the value.

Costs	Well	Borehole
costs, LTL		
The average annual installation, operation, and maintenance costs, LTL	822.25	1,084.75
The average annual water consumption, m^3	180	180

In a similar way, during the preparation of the methodology, were defined the following main parameters, needed to calculate the benefit damage component **"Increased sewage treatment services availability" value of estimate:**

1. The most common, corresponding technical parameters of central waste treatment service, individual service means between Lithuanian population is:

    a. Local sewerage with treatment facilities;

    b. Waste water storage tank;

2. The capacity of technical equipment, corresponding minimum consumption parameters, is serving for 180m^3 of sewage per year (based on average annual water consumption)

3. The main components of individual sewage disposal service equipment, construction works, and maintenance components are:

    a. Local sewerage with treatment facilities;

        i. Contract works (site preparation for wastewater treatment equipment, preparation of communication channels, other work);

        ii. Equipment (sewage treatment equipment (basic structural parts - body, inspection hood, the bio-load, diffuser, inlet pipe, outlet pipe, air supply pipe, blower), pipes / tubes, installation);

        iii. Operating costs (maintenance (work), energy (electricity), accumulated waste (sludge) periodic removal by specialized transport (sanitation truck)).

    b. Waste water storage tank;

        i. Contract works (excavation, concrete rings (or analog), the hood, the installation of communication channels, other work);

        ii. Equipment (specialized equipment is not provided);

        iii. Operating costs (maintenance (work), periodic removal of accumulated waste water by specialized transport (sanitation truck))

4. Time series with calculated operating expenses are 20 years;

Benefit (damage) component "The availability of increased sewage treatment services" estimates value is recommended to convert on the basis of set out above main parameters. The individual, carrying out calculations can review market prices both at the level of the individual parameters as well as providing request of the entire installation price for these providers. More rational arguments for selection in the second case (wastewater storage tank) is to carry out price monitoring in accordance with the individual components, as this service in the market, as a whole, is not widespread. It is important to note that in both cases the price monitoring for generated waste (sludge) periodic removal and periodic removal of accumulated sewage (in case of waste water storage tank, this element, in terms of cost, forms an extremely important part). Also, at given time providing conversion of operating costs one should quote on other benefit (damage) components (i.e., value of the working day) and the corresponding conversion factor.

The following unitary sewage with treatment facilities and sewage storage tanks data were determined according to the specified parameters and steps for 2013:

Table 2. Data on unitary local sewage with treatment facilities and sewage storage tanks (Prices in Litas (2013)

Costs	Local sewerage with treatment facilities	Sewage storage tank
Average contract work and equipment price, LTL	15,000.00	3,500.00
The average annual maintenance costs (including periodic residual wastewater disposal / removal), LTL	750.00	3,600.00
The number of for average lost days per year for maintenance	1	1
One day monetary value, LTL	154.39	154.39
Time series, by years	20	20
Average total costs (over the entire time series), LTL	33,087.80	78,587.80
Average annual maintenance costs, LTL	904.39	3,754.39
Average annual installation and maintenance costs, LTL	1,654.39	3,929.39
Average annual amount of waste water, m^3	180	180

1.8. Urban development

1.8.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, including theoretical basis, calculation methodology, application instructions and value updating requirements, are presented in part I of the report.

1.8.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The benefit (damage) component selection was based on the list of approved general urban development sector projects (Table 66).

Table 23. Distinguished General Urban Development Sector Project Types

Project Type	Project examples
1. Public spaces and community infrastructure upgrades and air quality improvements	1.1. Renovation of the central part of the city 1.2. Renovation of abandoned residential area 1.3. Conversion of unused urban zones 1.4. Renovation of the areas between renovated apartments 1.5. Park renovations 1.6. Investments in street-cleaning technology to reduce air pollution in cities
2. Renovation of apartment complexes	2.1. Renovation of apartment complexes with improvements in energy performance

Source: designed by BGI Consulting and CSIL Milano in accordance with SFMIS and strategic planning documents and the Republic of Lithuania ministry of environment information.

Urban development initiatives are focused on material wealth renewal, covering private and public buildings and spaces. Infrastructure investments are sometimes combined with soft measures, including business support, training and vocational training, social inclusion, etc. The cost-benefit calculation purposes in this section discusses only the infrastructure components of urban development. For the evaluation of other integrated urban development sector investments, it is recommended to apply the relevant sectoral conversion factors and benefit (damage) components.

Urban development interventions aimed at integrated urban development to satisfy the needs of residents and business groups[224]:

- Increasing the amount of local services and quality improvement;
- Aesthetic or functional value increase in public spaces;
- The development of the quality and quantity of recreational resources ;
- Business opportunities for improving the quantitative and qualitative aspects;
- The value increase in urban real estate;
- The increase in social inclusion.

In conclusion, the urban development projects increase the amount of goods and services for a certain territory "users" (which can be both residents and tourists as well as a business) and improve their quality. The main expected benefit of integrated urban development projects arises from the overall outcome of interventions and covers an increase in the attractiveness of a specific area.

Individual urban development projects or their components provide other benefits. For example, a multi-complex energy performance improvement and street cleaning machines usage reduces air pollution.

The following table presents a detailed explanation of benefit (damage) component selection (Table 67).

Table 24. Benefit (damage) component selection arguments

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. The increase in area attractiveness for households	Direct effect	The increase in attractiveness of the residential area may be due to a combination of different interventions where this methodology is expressed in public spaces and residential buildings renovation. These benefits are in line with EU priorities for cohesion policy for 2014-2020 Lithuania's national strategic objective to increase population's positive opinion about their residence (city) to 15 % by 2020. (2014-2020 m. National Progress program).
2. The increase in area attractiveness for businesses	Direct effect	The attractiveness of the city is also associated with all the opportunities for business development. Interventions to provide adequate space for business and retail shops to settle (industrial and commercial real estate, renovation and retail spaces suitable for renovation), creates a favorable environment for business investment. This is an additional aspect to the development of favorable household conditions.
3. Energy performance	Direct	The socio-economic impact (benefit and damage) component of relevant

[224] Hereunder „Urban Development in the EU:50 Projects supported by the European Regional Development Fund during the 2007-13 period, 2013 March , European commission"
http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/50_projects/urban_dev_erdf50.pdf

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
improvement of buildings	effect	apartment renovation projects. Impact component includes two benefits: – Energy consumption cost reduction: it is named as one of the main objectives of the Lithuanian energy sector[225]; – Convenience increase due to better insulation and higher temperatures inside buildings. The benefits mentioned in the studies analyzing the impact on the reconstruction of buildings[226], and 2013 EIB CBA guidelines.
3. Carbon dioxide (as a greenhouse gas) emission reduction	External environmental impact	Apartment renewal by improving energy characteristics, can contribute significantly to reducing energy consumption, and hence the greenhouse gases (carbon dioxide and methane) emission reduction. Also, these gas emissions are a source of investments in bicycle lanes or refurbished spaces afforestation. Greenhouse gas emission reduction is the aim of EU and globally. It deals with the principle[227], of sustainable economic development, which is mainly based on the fight against climate change and to promote low-carbon emission economy.
4. Methane (as greenhouse gas) emission reduction	External environmental impact	
5. Air pollution decrease due to the energy performance improvement of buildings	External environmental impact	Air pollution is one of the strategic objectives of both the EU and Lithuania. Apartment renovation contributes to air pollution reduction and improves energy performance, because energy production usually leads to a certain amount of polluting compounds such as SO2, NOx and particulate matter. Such pollution is a source of investment in street cleaning technologies, as well as bicycle paths or refurbished spaces afforestation.
6. Changes air pollution caused by transportation	External environmental impact	

Source: designed by BGI Consulting and CSIL Milano.

The table in the annex 1 shows which benefit (damage) components are applicable to specific types of projects.

[225] Žr., pavyzdžiui, Nacionalinę energetinės nepriklausomybės strategiją.

[226] For example, Clinch J.P. and Healy J.D. (2001) "Cost-benefit analysis of domestic energy efficiency", Energy Policy 29: 113-124.

[227] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Mainstreaming sustainable development into EU policies: 2009 Review of the European Union Strategy for Sustainable Development, COM/2009/0400 final.

1.8.3. Calculation Methodology and Application Instructions

1. The increase in area attractiveness for households and businesses

Attractiveness of the residence area, which is understood as the various dimensions of urban life (social, cultural, economic, environmental, etc.), is related to the specific area and the quality of living conditions is seen as a key benefit of urban development [228]. Both theoretical literature and empirical research [229] justifies the view that people assign a certain value to more attractive places, the attractiveness of the concept in relation to the quality of services, recreational activities or goods (i.e., better environmental and landscape) and the availability of security and a sense of social inclusion.

In addition, the business location of choice issue when considering entrepreneurs[230] also welcomes the urban areas which have modern, well-equipped buildings and good access to high-quality public services and infrastructure (particularly in urban transport and electronic services), since these aspects can increase business productivity.

Calculation methodology and calculated estimate value

The easiest way to measure the willingness of local residents to pay for the living environment of comfort increase is to identify preferences expressed by the contingent valuation (the concept of the willingness to pay is introduced in Annex 2 of the social security sector). The qualitative research that analyzes the perception of life quality in different cities is often invoked for comparison purposes. Indicators of life quality are usually set by ranking different factors that have an impact on life quality[231]. On the other hand, to assign a monetary value to such preferences is not easy. In addition, contingent evaluation generally are expensive and time-consuming.

As an alternative, it can be applied to reveal the preferences of the method, specifically, hedonic price method, which is enough to accurately reflect the benefits of the increase in the attractiveness of the area (this approach focuses on the European Commission 2008. guidelines). Hedonic price approach is behavioral surveillance related to the goods being valued in other markets. It is usually observed in the real estate and the labor market. This method is based on the fact that price differences between otherwise identical buildings or jobs that are different in non-market goods or availability of harmful effects (such as pollution or job security), disclose information about the willingness to pay for such goods or reduction of harmful effects. For example, the green spaces have the positive influence on the adjacent house prices.

[228] Integrated sustainable urban development, Cohesion policy 2014-2020, The new rules and legislation governing the next round of EU Cohesion Policy investment for 2014-2020 have been formally endorsed by the Council of the European Union in December 2013

[229] See Quality of life in cities - Perception survey in 79 European cities, 2013 m. spalis, http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/urban/survey2013_en.pdf

[230] Depending on the nature of the activity, business entities are seeking to choose the most optimal urban area for the activity (for example offices of commercial banks - in the city center, furniture trading company – in the places, which can be comfortably reach, etc.)

[231] For example, The Economist Intelligent Unit conducted by the attractiveness of living survey are collected 30 qualitative and quantitative indicators ratings. These indicators reflect the broader five categories: stability, healthcare, culture and environment, education, infrastructure.

Real estate price can be considered as a variety of physical properties of the function. These physical properties can reflect a wide range of areas in which the property is located. There are three characteristics which determine the price of housing sub-groups:

- - Internal and structural properties (such as size, high building year of construction, comfort, space (room) number, type of heating, etc.).;
- - Characteristics of the area (for example, green spaces and natural recreational facilities closeness, site security);
- - Territorial characteristics (for example, cultural and social infrastructure - schools, health care centers, museums, public libraries - proximity and accessibility of public transport, shopping centers, job proximity, etc.).

For heterogeneity of real estate and the real value of the assets of factors affecting the number of situational uniqueness, a country-wide value may not be applicable, because the value of the benefit should be calculated separately for each particular project or group of projects. For this purpose, a standard calculation methodology is advised, and the final value is calculated in each case based on the specific project and location data reflecting. Such data is:

- - Urban Development Intervention coverage (intervention in the urban area as a percentage) and intensity (wide integrated package of actions or only very few concentrated action). The higher the coverage and intensity, the greater the expected real estate value of the percentage increase;
- - Terrain features (usually associated with distance to the direct intervention), which can be calculated in different size effect. I.e. renovated or updated public spaces in front of the buildings standing value increased more than those who are not affected by the project in an urban area;
- - Building types (luxury, residential or commercial[232] buildings). Different types of interventions may unequally affect different types of buildings. For example, urban transport accessibility increase may have a greater impact on commercial and residential buildings than luxury buildings.

Real estate values increase unit value (LTL/ m2) should be determined by reference to a similar zone and similar urban development interventions affected by the real estate unit value. Depending on the scale of intervention and the nature of the real estate value of the possible increase in the range can be very broad, such as grand events (such as the Olympic Games or World Cup) of the enormous impact on investments in real estate values increase could reach up to 100 % of the initial real estate value[233].

Interviews with real estate agencies could provide information on the most significant real estate prices affecting aspects of a certain time and a certain place and may be used in formulating the assumptions on price increases. As indicative reference values can be used to present the figures in Table 68 by a group of experts identified on the basis of individual experts CBA application experience and expert consensus group. In exceptional interventions in the events of or in other specific justified reasons, since these values may be derogated from, such as a large scale renovation and modernization of blocks of flats with the aim

[232] Although the increase in the value of commercial buildings really reflects the increases of the attractiveness for business, which is a different kind of benefit, the calculation methodologies and data sources are the same as in the case of the evaluation of the benefits for the population.

[233] Kavetsos, G. (2012), The Impact of the London Olympics Announcement on Property Prices, Urban Studies, vol. 49, no. 7.

of improving the services they provide comfort expected increase in the value of real estate may exceed 15 %.

Table 25. The range of intervention types and increase in offered price

Intervention Type	Description	Price increase in the most affected area (%).	Price increase in the area of average effect	Price increase in the least affected area (%).
Having a significant impact	The project includes extensive integrated package of actions aimed at a broad (e.g., accounting for over 30 % of the total city area) area) and / or the most important and the most visible parts of the city (the historic center, areas with a tourist value, historical and cultural heritage sites and the like).	10–15	5–10	0–5
Having an average impact	The project involves integrating actions targeted to a relatively concentrated area of the city and / or with low intensity (i.e. the degree of integrity) and aimed at the average visibility parts of the city.	5–10	3–5	0–3
Having a little impact	The project involves a very localized interventions targeted to one specific area (for example, a small green area, the river shore, the town square and so on.) That does not include the most important areas of the city and is only visible to local residents.	1–5	0.5–1	0–1

Source: designed by BGI Consulting and CSIL Milano.

Therefore, each project could be based on a relatively homogeneous typology of residential areas and on this basis the project's impact on the territory assigned to the aggregated real estate performance indicators.

Once the project is broken down into small individual components, it is appropriate to analyze only a portion of each of the analyzed territory real estate.

The last analysis considered an important aspect of time period, during which the price change occurs. The process of real estate gains may last from one to several years. The processes of value increase may begin before construction starts (sometimes entirely appropriate and convincing message on future construction could lead to price increases[234]) and continue for several years after the end of the project. The estimated total benefit should be during this period based on the expected price growth curve. The assumption of a price change in time is very important because the benefits are discounted to present value.

In order to calculate the expected benefit value the formula below must be applied:

[234]Kavetsos, G. (2012), The Impact of the London Olympics Announcement on Property Prices, Urban Studies, vol. 49, no. 7.

$$B_{[T]} = \sum_{ij} S_{ij} * V_{ij} * \Delta_{ij}\%$$

Where *i* is the type of real estate (commercial, luxury, economic / residential[235]); *j* – area type (project area, zone, which is near the project area[236]); S - *i* type real estate's total area in *j* type territory ; V – *i* type real estate's average market price (for example, real estate registry data) in *j* type territory; Δ% - *i* type real estate's price increase percentage in *j* type territory, T - the period during which all benefits fully occur (i.e. occurs in the project lead to price growth processes).

Result (B) is determined by the project estimated property values increase.

Comparison with other countries. The proposed hedonic price method, as well as the preferences of the evaluation method can be applied in any country, using the proposed formula. Table 25 Indicative reference values are applicable to any country, but different states vary in real estate prices (variable (V), in the proposed formula), and real estate value increase (B), caused by the project, will be different.

Application instructions

In order to adapt the proposed methodology for calculating the urban development projects of real estate value increase benefits require the following information:

1) To analyze the municipal urban area **classification** by homogeneous (influence of the price scale aspect) zones;
2) Project in the area affected by the property type, quantity and size **identification**;
3) ***Real estate value calculation***: The information on each property's type unit value (LTL / m2) has to be collected; for these purposes the real estate registry or an alternative data might be used (such as market reviews or real estate expert survey);
4) ***Value increase calculation***: Different areas with different types of real estate value of the percentage increase (for the project) should be determined on the basis of real estate registry information showing how such projects are affected in similar zones in the real estate value. If such information is not available, it can rely on a real estate expert surveys (interviews) or the data in Table 25 indicating reference values.
5) ***Rating:*** *the following formula must be applied* $B_{[T]} = \sum_{ij} S_{ij} * V_{ij} * \Delta_{ij}\%$.

The following is a calculation example of the real estate value increase affected by the project.

[235] If the data accessible, the project promoter may choose to use a detailed distribution.

[236] Zone, which located near the project area, in turn, can be divided into different zones, if the intended effect will be different. For example, when the regeneration of the central part of the city is executing, near the project area located area can be divided into: 1) territory, covering the streets and buildings in the city center, that are not directly exposed of the project interventions; 2) territory, covering streets, which are close to the city center; 3) territory, covering the streets adjacent to the main point, which connects the peripheral areas with the city center.

Insert 18. Hedonic price method of urban development: a calculation example

Let's say there are 40,000 inhabitants in a territory of the total area of 20 km^2, conducted a large-scale integrated intervention aimed at public spaces in the city center upgrade. Project affected area covers 65 % of the historic city center. The project, with a value of 22.5 million LTL, includes the following components:

- 5 km section of the street reconstruction, including reconstruction of the pavement squares;
- Rainwater and lighting system reconstruction;
- District of green spaces restoration;
- bicycle routes construction;
- public spaces in the central streets of the development and creation of pedestrian zones;
- Public buildings facade renewal.

It is expected that the above-mentioned interventions significantly improve downtown aesthetic and functional aspects, and residents and visitors will create a new shopping and entertainment opportunities. It is assumed that the improvement of living conditions will be felt not only reconstructed the city center, but also the surrounding areas. The project affected area (i.e. the area in which the area is likely to manifest itself more attractive for households and businesses increase benefits) account for 60 %. Total area of the city and includes not only the project directly affected the central part of the city but also in some neighboring areas.

Project affected area was divided into 4 different areas, street sections within zones according to their distance from the refurbished spaces. In order to assess the likely impact of the planned interventions of various types of real estate value it has undergone several interviews with real estate experts. Areas, and the expected impact are given in Table 69.

Table 26. Zones and expected increase in different types of real estate values

Zone	Description	Commercial	Luxurious	Economical
A	Directly affected area in the city centre (including streets and buildings), facing the greatest effects of the interventions.	10 %	8 %	6 %
B	The area covering the inner-city streets and buildings that are not directly exposed to the project interventions.	5 %	5 %	4 %
C	The area that includes the the streets close to the city centre.	2 %	2 %	1.5 %
D	The area covering the streets adjacent to the main point, which connects the peripheral areas of the city centre.	1 %	1 %	0.5 %

Let's assume that the real estate and unit values of the data was obtained from the real estate register. The data is summarized in Table 70.

Table 27. The total area and unit value of different types of real estate situated in separate zones

Zone	Individual types of real estate, the total area (m2)			The real estate unit values by type prior to implementation of the project (LTL/ m2)		
	Commercial	Luxurious	Economical	Commercial	Luxurious	Economical
A	6,636	6,083	4,148	3,880	3,990	3,200
B	54,154	19,692	24,615	3,880	3,990	3,200
C	19,172	20,915	13,072	2,780	2,840	2,100
D	6,214	6,779	2,825	2,200	2,150	1,950

For the purposes of hedonic price method estimates the attractiveness of the area increase in benefits is equal to 25,874,059 LTL, of which 14,283,446 LTL (55 %.) Include commercial real estate, and 11,590,613 (45 %). - Living (luxurious and economic), real estate (as shown in Table 71).

Table 28. The total net benefit from the application of hedonic price method

Zone	Commercial	Luxurious	Economical
A	2,574,768	1,941,694	796,416
B	10,505,876	3,928,554	3,150,720
C	1,065,963	1,187,972	411,768
D	136,708	145,749	27,544
Iš viso	**14,283,315**	**7,203,968**	**4,386,448**

It is expected that the project lead to price growth process will begin only after the end of the project and fully materialize within three years. It is hoped that the total impact during this period will be as follows: 20 % during the first year, 30 % - during the second and 50 % - during the third year.

Source: designed by BGI Consulting and CSIL Milano.

Estimate update instructions

The percentage increase in value (Δ%) depends on each particular project and should be calculated according to the latest data on real estate (i.e. how similar projects in areas are affected by comparable property value). Table 25 Indicative percentage increase in the value of the reference values should not be updated.

2. Energy performance improvement of buildings

Providing for the renovation projects could result in the benefits arising from energy performance improvement of buildings is demonstrated by the increase in thermal comfort and / or reduced heating costs. Energy performance improvement of buildings component reflects the increased thermal comfort, while the drop in heating costs in economic prices converted using the conversion factor.

The socio-economic impact (benefit and damage) component and the estimate is the same as described in the energy sector chapter.

Component and estimates in the urban development sector

The socio-economic impact (benefit and damage) component of topical apartment renovation projects. In addition to the impact of multi-component energy performance improvement as well as greenhouse gas emission reduction and air pollution (see other components).

Energy performance improvement of buildings component has a connection with the area more attractive for households and businesses increase component. I.e. Increased thermal comfort and / or decrease in the heating costs are included in the price of real estate. In a case where a project involves both a certain territory for the renovation and the territory around the blocks, it would be more appropriate to apply the area for households and businesses (also not forgetting to assess greenhouse gas emissions and air pollution reduction in the positive impact of the reduced energy consumption).

If the analysis of the investment is limited to apartment energy characteristics, it is appropriate to apply the energy performance improvement of buildings component. The estimate of the application instructions are in the energy sector chapter. Estimate of the application may be illustrated in the example below:

Insert 19. Energy performance improvement of buildings: evaluation sample

In this case, the project, covering the apartment facade insulation and heating system replacement, is analysed. Suppose that the average non-renovated apartment owner pays an annual charge of 1,000 monetary units for the energy required to maintain 18°C (whereas the standard thermal comfort temperature is 22 ° C).

Let's say that the project aims to increase the internal temperature (from 18ºC to 22ºC temperature thermal comfort) while maintaining the same cost (1,000 monetary units) as well as before the implementation of the project. Financial analysis would record no cost savings, but from an economic perspective, the energy costs incurred contra factual scenario (i.e. the scenario without the project) to maintain thermal comfort 22ºC temperature is higher than the scenario with the project implementation (for energy performance improvement). Suppose in the contra factual scenario, those costs would be equal to 1,200 litas. As a result, there are benefits associated with higher temperatures mediated comfort that fail to capture the energy pricing system. The energy at the applicable conversion factor, such as 0.8, this benefit would be equal to:

Benefit = (1,200 * 0.8) – (1,000*0.8)=160

Source: Designed by BGI Consulting and CSIL Milano.

3. Carbon dioxide (as a greenhouse gas) emission reduction

Apartment renewal by improving energy characteristics, can contribute significantly to reducing energy consumption and, consequently, the greenhouse gas emission reduction. Also, these gas emissions are a source of investments in the pedestrian / bicycle paths or refurbished spaces afforestation.

In view of the greenhouse gas emissions have a global impact on climate change, there is no difference, in Europe or the world, and these gases are emitted. Accordingly, the estimates applied are the same for all sectors.

Carbon dioxide (as a greenhouse gas) emissions reduction in component and its estimates are the same as those described for the transport sector under (Component 6. Carbon dioxide (as a greenhouse gas) emission reduction ").

Component and estimates in the urban development sector

Benefit component estimates in the instructions are located in the transport sector chapter. Greenhouse gases (including carbon dioxide) emissions in changes on the project should be presented in the feasibility study of the project, particularly the environmental impact assessment report (where this is required).

4. Methane (as greenhouse gas) emission reduction

In addition to carbon dioxide (CO2) greenhouse gases also include methane (CH4). In order to reflect the methane (CH4) emissions costs CH4 emissions in tons must be converted into CO2 equivalents. For this purpose, a global warming potential *(GWP)* factor is used [237]. As in the case of the environmental sector, methane (CH4) emissions (tons) conversion to carbon dioxide (CO2) equivalent of the applicable rate is equal to 25[238].

Component and estimates in the energy sector

Benefit component estimate analogous application instructions are included in the environmental chapter. Greenhouse gas (including methane) emission results in implementation of the project should be presented in the feasibility study of the project, particularly the environmental impact assessment report (where this is required).

5. Air pollution decrease from energy performance improvement of buildings

Apartment renewal by improving energy characteristics, contributes to air pollution decrease, as the production of energy is usually distinguished by a certain amount of polluting compounds such as SO2, NOx and particulate matter.

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[237] The ratio reflects the CO2 content that has the same global warming potential as one unit of CH4, measured over time.

[238] As energy project time horizon is usually more than 20 years' worth of methane (CH4) have a global warming potential (GWP) value, 25 times higher than CO2.

It should be noted that reducing apartment energy consumption and in the case of air pollution in the city streets with a reduction in the unit value of the damage caused by pollutants is different. For instance, a certain reduction of the size of particulate matter in the city center streets positive effects will be greater than the same amount of reduction in particulate emissions in the city outskirts or outside in the heat-producing plant. Therefore, the evaluation of apartment energy reduction of air emission reduction benefits are applicable to the estimates in the energy sector chapter (component 7. Air pollution changes).

Component and estimates in the urban development sector

The estimate of the application instructions can be found in the energy chapter. Unitary air pollutants individual costs must be multiplied by the set emission change. Such project leading to emission changes should be submitted to the project feasibility study, particularly in the environmental impact assessment report (where this is required).

6. Changes in air pollution caused by transportation

The source of air pollution caused by transportation decrease is investments in street cleaning technologies, as well as investments in bicycle lanes or refurbished spaces afforestation.

As mentioned above, the unit value of the air pollution reduction in the streets and the energy consumption reduction in apartments is different. The evaluation of bicycle lanes or street sweepers of air emission reduction benefits are applicable to the transport sector in the transport chapter where estimates are presented (Component 5. Air pollution reduction).

Component and estimates in the urban development sector

Estimate application instructions are resented in the transport sector chapter. Unitary air pollutant individual costs must be multiplied by the set emission change. Such emission changes caused by the project implementation should be submitted in the project feasibility study, particularly in the environmental impact assessment report (where this is required). For example, street cleaning machines mainly contribute to particulate emission reduction[239].

[239]Vilnius City Municipality Environment and Energy Department of Environmental Protection Division. Ambient air quality management program for 2012-2014 and its implementation plan report for the year 2012. Vilnius. - 2013.

1.8.4. The table of urban development sector in the socio-economic impact estimates

In summary, the socio-economic impact estimates are set out in the form of a table (Table 72). According to the technical requirements of the task, the table of indicators must be linked to a service provider established conversion rates in order to ensure that there are no benefits and damages double-counting. Nevertheless, none of the established estimate is related to the determination of costs applicable to the conversion rates, and benefits and claims, that’s why there is no risk of double-counting.

Table 29. Urban development sector to determine the socio-economic impact estimates

<table>
<tr><th>Sector</th><th>Conversion factors *</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload (table of strong, reliable and significant ratings (at least three)</th><th>Quantitative expression, LTL ** (in 2013 prices))</th></tr>
<tr><td>Urban development</td><td>N/a</td><td>N/a</td><td>1. Increase in area attractiveness for households and businesses</td><td>Measured in real estate price increase. As indicative reference values the following ranges can be used:
<table>
<tr><th>Intervention Type</th><th>Price increase in the most affected area (%).</th><th>Price increase in the the area of average effect</th><th>Price increase in the least affected area (%).</th></tr>
<tr><td>Having a significant impact</td><td>10–15</td><td>5–10</td><td>0–5</td></tr>
<tr><td>Having an average impact</td><td>5–10</td><td>3–5</td><td>0–3</td></tr>
<tr><td>Having a little impact</td><td>1–5</td><td>0,5–1</td><td>0–1</td></tr>
</table>
</td></tr>
<tr><td>Urban development</td><td>N/a</td><td>N/a</td><td>2. Energy performance improvement of buildings</td><td>Standard thermal comfort temperature: 22 ° C.</td></tr>
<tr><td>Urban development</td><td>N/a</td><td>N/a</td><td>3. Carbon dioxide (as a greenhouse gas) emission reduction</td><td>LTL / ton of CO2
<table>
<tr><th rowspan="2">Application Year</th><th colspan="3">The economic value</th></tr>
<tr><th>The lower value</th><th>The central value</th><th>The upper value</th></tr>
<tr><td>2010</td><td>28</td><td>86</td><td>169</td></tr>
<tr><td>2020</td><td>59</td><td>138</td><td>242</td></tr>
<tr><td>2030</td><td>76</td><td>190</td><td>345</td></tr>
<tr><td>2040</td><td>76</td><td>242</td><td>466</td></tr>
<tr><td>2050</td><td>69</td><td>293</td><td>622</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Sector</th><th>Conversion factors *</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload (table of strong, reliable and significant ratings (at least three)</th><th>Quantitative expression, LTL ** (in 2013 prices))</th></tr>
<tr><td>Urban development</td><td>N/a</td><td>N/a</td><td>4. Methane (as greenhouse gas) emission reduction</td><td>Methane (CH4) emission (tons) conversion to carbon dioxide (CO2) equivalent to the applicable rate: 25.</td></tr>
<tr><td>Urban development</td><td>N/a</td><td>N/a</td><td>5. Air pollution decrease due to energy performance improvement of buildings</td><td>LTL / ton of pollutant (2013 prices), while investments reduce energy consumption in buildings:
<table>
<tr><th rowspan="2">Pollutant</th><th colspan="2">The economic value</th></tr>
<tr><th>Low emission excreted</th><th>Highly isolated issue</th></tr>
<tr><td>NO_x</td><td>13,801</td><td>11,351</td></tr>
<tr><td>SO_2</td><td>13,729</td><td>12,531</td></tr>
<tr><td>SP10</td><td>2,067</td><td>879</td></tr>
<tr><td>SP2,5</td><td>46,380</td><td>21,928</td></tr>
<tr><td>NMVOC</td><td>214</td><td>214</td></tr>
<tr><td>NH_3</td><td>8,657</td><td>8,657</td></tr>
</table></td></tr>
<tr><td>Urban development</td><td>N/a</td><td>N/a</td><td>6. Air pollution caused by transportation</td><td>LTL / ton of pollutant (2013 prices), while investments reduce air pollution in the streets:
<table>
<tr><th colspan="2">Pollutant</th><th>Lithuania</th></tr>
<tr><td colspan="2">NO_x</td><td>15,638</td></tr>
<tr><td colspan="2">NMVOC</td><td>1,738</td></tr>
<tr><td colspan="2">SO_2</td><td>20,850</td></tr>
<tr><td rowspan="3">SP2,5</td><td>City</td><td>1,243,209</td></tr>
<tr><td>Town</td><td>403,978</td></tr>
<tr><td>Country</td><td>248,468</td></tr>
<tr><td rowspan="3">SP10</td><td>City</td><td>496,936</td></tr>
<tr><td>Town</td><td>161,591</td></tr>
<tr><td>Country</td><td>99,040</td></tr>
</table></td></tr>
</table>

Comments:

* Indicators table must be associated with a service provider established conversion rates in order to ensure that no benefits and damages are double-counted.

** Unless otherwise specified.

1.8.5. Annexes (urban development sector)

Annex 1. The benefit / damage elements, applicable to different types of projects

Project type	Applicable benefit (damage) components*
1. Public spaces and community-based rehabilitation of infrastructure and air quality improvement	1. Increase in area attractiveness for households and businesses 3. Carbon dioxide (as a greenhouse gas) emission reduction 6. Changes in air pollution caused by transportation
2. Apartament renovation	2. Energy performance improvement of buildings 3. Carbon dioxide (as a greenhouse gas) emission reduction 4. Methane (as greenhouse gas) emission reduction 5. Air pollution decrease due to energy performance improvement of buildings

* A given project may not be relevant to all socio-economic impact (benefit and damage) components.

1.9. National defence

1.9.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.9.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The choice of socio-economic impact (benefit and compensation) components was based on the identified common typical projects of the national defence sector. **In agreement with the Ministry of National Defence of the Republic of Lithuania[240], it was identified and approved a project type of the national defence sector:**

- **investments in a technique/infrastructure permitting to perform peacetime tasks and related to the performance of search and rescue and monitoring functions.**

However, even such distinguished investments in technique/infrastructure permitting to perform peacetime tasks cannot be treated solely on results of the cost-benefit analysis in all cases, i. e. such investments can be more like an object of the political agreement.

In order to determine estimates of the socio-economic impact, applied to the identified infrastructure, it is necessary to identify the benefit of the infrastructure, used for search and rescue and monitoring functions (see the Box given below).

[240] 2013-06-30 letter No. 12-01-1001 of Ministry of National Defence of the Republic of Lithuania.

Insert 20. Completed search and rescue and monitoring tasks

According to the information provided by the Ministry of National Defence of the Republic of Lithuania, search and rescue and monitoring functions will include fire-extinguishing, transportation of patients and donors, rescue of drowning victims, search for the lost people, etc. For instance, since 1994, the military helicopters were used for these tasks[241]:

- 11 times – for fire-extinguishing (for instance, during a peat fire, the helicopter can be used to pour water in small or impassable to vehicles marshy areas);

- 34 times – for urgent transportation of patients ;

- 45 times – to transport donated organs;

- 47 times – for rescue of drowning victims in the sea or in the lagoon;

- 60 times – for other aid to civil institutions cases.

During the specified period, about 170 human lives were saved.

Source: created by BGI Consulting and CSIL Milano in accordance with the information provided by the Ministry of National Defence of the Republic of Lithuania.

According to this information, the benefit of the analysed infrastructure is related to:

- the preservation of human lives;
- the preservation of human health;
- the economy of ecological damages regarding the early fire detection and faster extinguishing.

A detailed ground for the choice of socio-economic impact (benefit and compensation) components (Table 73).

Table 30. Arguments for the choice of socio-economic impact (benefit and damage) components

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Value of a statistical life	Direct effect	One of the key indicators, specified in the 2013-2015 strategic action plan of the national defence system, is the assurance of the Lithuanian military assistance in peacetime tasks to the state and municipal institutions in the cases, specified by the Law of the Republic of Lithuania (specified to ensure 100 percentages), and one of the main tasks is the rescue and search function which is directly related to the saving of human lives. As stated in 2008 guidelines of EC, the value of

[241]Source: http://www.kam.lt/lt/naujienos_874/aktualijos_875/ietuvos_kariuomene_pasirase_sutarti_del_triju_sraigtasparniu_isigijimo.html.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		statistical life reflects the benefit of the avoided death.
2. Value of life years	Direct effect	Arguments similar to previous impact component. Peacetime tasks of Lithuanian military include urgent transportation of patients and donated organs, which allows to prolong the life of patients and / or to improve health. The benefit of longer life for patients is reflected by the value of life years, i.e. constant value assigned to every year which was lost because of premature death. In addition, the state of health can be reflected using QALY (quality of life year rating) values.
3. Decrease in air pollution	External impact on environment	One of the most important peacetime task of Lithuanian military is to assist in extinguishing fires (for instance, large forest fires and peat fires), as well as the function of environmental monitoring and air surveillance. Faster observation of fire sources and their neutralization leads to lower losses of air pollution.
4. Decrease in carbon (as a greenhouse gas) emissions	External impact on environment	Arguments similar are to previous impact components. In this case, impact component reflects the benefit of reduced carbon dioxide, as a greenhouse gas, emissions (preserved forest areas will serve in appropriating CO_2).

Source: created by BGI Consulting and CSIL Milano.

Search and rescue infrastructure can also have other benefits, for instance, the implementation of NATO's air policing functions would be impossible from the airport, located in Lithuania, without search and rescue helicopters. However, such an effect is highly dependent on specific investments and environmental factors, forced in a particular situation, therefore an attempt to offer any estimates and to make calculations would be very speculative. For instance, fighters, implementing the NATO air policing functions, can be moved to airports of the neighbouring countries not because of the lack of search and rescue helicopters but because of too low defence spending of Lithuania and / or political decisions.

1.9.3. Calculation Methodology and Application Instructions

1. Value of statistical life

One of the main peacetime tasks of Lithuanian military includes search and rescue function which is directly related to the saving of human lives. The value of saved human lives is reflected by the value of a statistical life.

In the economic literature, the value of statistical life (VSL)[242] is described as the sum, which, according to the public point of view, would be cost-effective to spend for an unnamed person's life preservation [243]. This component of the socio-economic impact and its estimate is the same as described in the section of the health protection sector.

Component and estimate application to national defence sector

Instructions on the estimate application are similar to those, provided in the section for the health sector. In order to evaluate the benefits of search and rescue tasks, the SVL estimate is multiplied by the number of lives, who are likely to be saved because of the investments during a particular year. Every year of the analysed period, the value of lives, which are likely to be saved, is discounted to the present value using a social discount rate.

2. Value of life year

In certain cases, search and rescue operations may not save a live but help prevent health impairments. Also, peacetime tasks of Lithuanian military include urgent transportation of patients and donated organs, and this allows to prolong the life for the patient and / or to improve the state of health

Such benefits can be calculated using the value of life years (VLY) which reflects a constant value, attributed to each year of life, which was lost due to premature[244]. VLY is used to assess changes of the probable life length, for instance, due to the possibility to deliver the donated organ by a helicopter and therefore to prolong the life length for the patient. In addition, using values of the quality of life year rating (QALY), the state of health can be reflected.

This component of the socio-economic impact and its estimates are the same as described in the section of the health protection sector.

Component and estimate application to the national defence sector

VLY is used to assess changes of the probable length of life, for instance, due to possibility to deliver the donated organ by a helicopter and therefore to prolong the patient's life length. Counting example is given in the Insert 23.

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[242] "Statistical life" is the term used in view of the fact, that most of the security measures aims are to reduce the risk of death, rather than to specific deaths. See Abelson P. (2010), The Value of Life and Health for Public Policy, Macquarie University, http://www.appliedeconomics.com.au/pubs/papers/pa03_health.htm.

[243] See Björn Sund (2010), *Economic evaluation, value of life, stated preference methodology and determinants of risks*, Örebro Studies in Economics 21, Örebro University. OECD (2012), *Mortality Risk Valuation in Environment, Health and Transport Policies*, OECD Publishing. http://dx.doi.org/10.1787/9789264130807-en.

[244] See, for example, Willinger, M. (2001), *Environmental Quality, Health and the Value of Life*, Policy Research Brief N.7.

Insert 21. The counting example of the value of an extra year of life

Let say that the transported donated organ will prolong the probable length of remaining life for the patient from 5 up to 15 years. The specific value of a statistical life for the particular patient is calculated by the following formula:

$$\text{Specific VSL}=\text{VLY}*\sum_{t=0}^{T-a-1} 1/(1+r)^t$$

T-a is the length of remaining life, and *r* is the norm of social discount.

The value of statistical life for the patient would be equal to 267,461 LTL without the transplantation of the organ; whereas it would be 613,168 LTL when an organ would be transplanted and the length of remaining life would be prolonged up to 15 years. Thus, the socio-economic benefit consist of 345,707 LTL.

If two such patients attain the transplantation of the organ due to investments per a year, an annual benefit would be equal to 691,414 LTL.

Source: created by BGI Consulting and CSIL Milano.

In addition, using values of the quality of life year rating (QALY), the state of health can be reflected in. For instance, if the length of life would be prolonged by one year because of the organ transplantation, but the pain would be felt it would be suffered, the value of QALY would be low. VSL multiplying by QALY, it results the value of VSL, adjusted by the aspect of the quality. QALY index can take a value between 1 (perfect health) and 0 (death) or even of the negative value (if a person is experiencing extreme pain and great suffering). If an individual should spend an extra year of life in a wheelchair, the value being in the 0-1 range would be attributed to the extra year of life in order to be taken into account this fact. One of tools, providing a set of assessments for the quality of life (utility values for health), is EQ-5D[245].

There is a possible situation that the value of QALY of the remaining years of life for the patient would be low without the organ transplantation but after the organ transplantation, this value would increase. In this case, the source for socio-economic benefit would be not only the prolonging of the probable length of remaining life, but also the improvement of health.

In order to evaluate what prolonging of the probable length of remaining life and / or the improvement of the status of health, the project implementer can rely on historical experience (since 1994 Army helicopters were used 34 times for urgent transportation of patients and 45 times for the transportation of donated organs[246]).

[245] A standard instrument, used to asset the state of health (http://www.euroqol.org).

[246] Source: http://www.kam.lt/lt/naujienos_874/aktualijos_875/ietuvos_kariuomene_pasirase_sutarti_del_triju_sraigtasparniu_isigijimo.html.

3. Decrease in air pollution

One of the most important peacetime task of Lithuanian military is to assist in extinguishing fires (for instance, large forest fires and peat fires), as well as the function of environmental monitoring and air surveillance. A faster observation of fire sources and their neutralization leads to lower losses of air pollution.

This component of the socio-economic impact and its estimates are the same as described in the section of the energy sector.

Component and estimate application to national defence sector

Instructions on the estimate application are similar to those, provided in the section for the energy sector. During the forest fires, pollutants, which have a negative impact, in particular on human health, spread in the air. The list of pollutants should include[247]:

- ammonia (NH_3),
- non-methane volatile organic compounds (NMVOCs),
- nitrogen oxides (NO_x),
- sulphur dioxide (SO_2).

Single values of these pollutants costs are given in the section for energy sector[248].

In order to apply single values of these pollutants costs, the information about the amount (tonnes) of pollutants, emitted during the fire, for a single unit of the forest area (e. g. a hectare). This information is published in inventory reports on national amounts of air pollutants emissions levels (Table **Error! Reference source not found.**).

Table 74. Pollution factors of burned forest (the amount (tonnes) of pollutants for 1 ha)

Pollutant	Pollution factor, t/ha
NH_3	0.03
NMVOC	0.354
NO_x	0.135
SO_2	0.03

Source: created by BGI Consulting and CSIL Milano according to the Lithuania's national greenhouse gas emission inventory report 2010.

In order to determine the annual amount of the benefit, the project implementer should assess historical information, what size of the forest was managed to save due the use of the infrastructure, which is similar to bought-in one, for the monitoring and / extinguishing operations. Indicated area of the forest, which is

[247]For instance, See. Lithuania's national greenhouse gas emission inventory report 2010

[248] Applied values, which are calculated for the low emission, (i.e. the value appointed to not higher than 200 m. above ground emitted pollutants).

likely to be saved because of the in-bought infrastructure per a year, is multiplied by pollution factors of individual pollutants and then by air pollution costs for a tonne of pollutants. It results an annual socio-economic benefit.

4. Decrease in carbon (as a greenhouse gas) emissions

Mainly the climate change or global warming effects are caused by emissions of greenhouse gases (GHG), especially - carbon dioxide (CO_2). During the fires the trees, which are important for its properties to absorb carbon dioxide (CO_2), are destroyed.

In accordance with a global impact of greenhouse gas emissions on climate change, there is no difference, where in Europe or in the world these gases are emitted. Accordingly, the applied estimates are the same for all sectors, and the component of the socio-economic impact and its estimate are described in the section for the energy sector.

Application of the component and estimate to the sector of national defence

Instructions on the application of the estimate are similar to those, provided in the section dedicated to the sector of energy. In order to apply a single estimate value, the information about the amount (tons) of CO_2 emissions, absorbed by a single unit of the forest area (e. g. a hectare) per a year, is needed. This amount varies depending on the maturity of the forest and the prevailing forest type (for instance, deciduous and coniferous stands). According to international sources, the average uptake of CO_2 could be 11 tonnes per 1 hectare per a year[249].

The forest area, which is likely to be saved per a year because of the bought-in infrastructure, indicated by the project implementer, is multiplied by the uptake factor value (11 t / ha per year), and then by the single estimate of the CO_2 costs and an annual monetary value of the impact is resulted.

[249] http://www.forestry.gov.uk/forestry/infd-889hsz

1.9.4. Estimates table of socio-economic impact of national defence sector

In summary, identified estimates of socio-economic impact are presented in a tabular form, set out in the Technical Task (Table 75). According to requirements of the Technical Task, the table of indicators should be linked to conversion coefficients, specified by the service provider in order to ensure that no double-counting of benefit and compensation. However, none of the established estimate is related to specified conversion coefficients, applied to costs, and no risk of double-counting of benefit and compensation appears.

Table 31. Estimates of the socio-economic impact identified for the national defence sector

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload (table of strong, reliable and significant ratings (at least three)</th><th>Quantitative expression, Lt</th></tr>
<tr><td>National defence</td><td>N/a</td><td>N/a</td><td>1. Value of a statistical life</td><td>990,047 LTL at 2013 prices</td></tr>
<tr><td>National defence</td><td>N/a</td><td>N/a</td><td>2. Value of life years</td><td>60,060 LTL at 2013 prices</td></tr>
<tr><td>National defence</td><td>N/a</td><td>N/a</td><td>3. Decrease in air pollution</td><td>LTL per tonne of emissions, at 2013 prices:
<table>
<tr><th>Pollutant</th><th>Economic value</th></tr>
<tr><td>NO_x</td><td>13,801</td></tr>
<tr><td>SO_2</td><td>13,729</td></tr>
<tr><td>NMVOC</td><td>214</td></tr>
<tr><td>NH_3</td><td>8,657</td></tr>
</table></td></tr>
<tr><td>National defence</td><td>N/a</td><td>N/a</td><td>4. Decrease in carbon (as a greenhouse gas) emissions</td><td>Litas per tonne of CO_2:
<table>
<tr><th rowspan="2">Applicati on years</th><th colspan="3">Central value</th></tr>
<tr><th>Lower value</th><th>Central value</th><th>Upper value</th></tr>
<tr><td>2010–2019</td><td>28</td><td>86</td><td>169</td></tr>
<tr><td>2020–2029</td><td>59</td><td>138</td><td>242</td></tr>
<tr><td>2030–2039</td><td>76</td><td>190</td><td>345</td></tr>
<tr><td>2040–2049</td><td>76</td><td>242</td><td>466</td></tr>
<tr><td>≥2050</td><td>69</td><td>293</td><td>622</td></tr>
</table></td></tr>
</table>

Note:

*A table of indicators must be associated with conversion coefficients established by a service provider in order to ensure that no double counting of benefits and losses will be during the process of counting.

1.10. Justice / Law Enforcement

1.10.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.10.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

Choice of components of benefit (damage) was based on the list of projects types confirmed by general justice/ law enforcement sectors (tabel 76).

Table 32. Separated Projects Types of Sector of General Justice / Law Enforcement Sector Projects Types

Project type	Project examples
1. Investments into buildings of imprisonment institution and their installation	1.1. Recontruction and capital repair of buildings of imprisonment institution (correction houses) 1.2. Relocation of Central Prison Hospital 1.3. Capital repair of engineering systems (heating networks, water supply) of imprisonmet institutions 1.4. acquisition of long- term property (weapons, special transport, medical equipment, technical equipment) for imprisonment institutions
2. Investment into buildings and their installation of expertise institutions	2.1. Installation of building of expertise institution and adjustment for its purpose and activity. 2.2. Acquisition of long- term property for expertise institution
3. Investment into court buildings and their installation	3.1. Reconstruction of building of regional (district) court 3.2. Acquisition of long- term property (cars, technical equipment) for the courts
4. Investment into other buildings and their intallation of law enforcement institutions.	-
5. Investment into creation and development of electronic services oriented into the final user.	5.1. Development of registers of the Central Mortgage Office 5.2. Establishment of information system of consumer protection

Project type	Project examples
	5.3. Electronic service for registration of legal entities (JAREP) 5.4. Electronic service in 5.4. Elektroninės paslaugos for the justice enforcement process
6. Investment into infrastucture which would move supplying of the present services into higher level of security, administration and accessibility	6.1. IT Security of the Centre of Registers and the Central Mortgage Office

Source: formed by BGI Consulting and by CSIL Milano according to SFMIS, documents of strategic planning and according to information of the Ministry of Justice.

The quidelines of European Commision of 2008 do not specify the actual provisions of 1-4 types of the projects. But cost and benefit of perfomed interventions in sectors of justice/ law enforcement are analysed in methodological documents or investigations of the United Kingdom, Australia and the United States of America[250]. The United Kingdom having the detailed analysis of the methodology and the collection of estimated values of socio-economic influence.

It was published special investigation reports which provided estimates[251] of cost caused by most actual criminal offences in the United Kingdom. These reports published in 2000 and 2005 provided information for estimation socio-economic influence of measures for the criminality reduction, for example, breaking into the housing was estimated 3,268 pounds sterling on the approved prices of 2003 year. According to the latest submitted investigations annual crime costs in England and Wales are between 35 and 60 milliard British pounds sterling[252] or between 600 and 1,100 pounds sterling to each citizens. Some investgations talks about higher numbers, for example it was calculated that annual costs of crime composed 2,295 pounds sterling for each citizen in Manchester (England).[253] Submitted evidence disclosure also in the other literature[254] that crimes causes huges costs to society irrespective of the type of crime. If it is provided investments into the sectors of justice/ law enforcement (for example, equipment of expertise institution), it will be prevented the influence of crimes or such influence will be decreased and the society could avoid significant social – economic costs.

[250]For example, Brand, S., Price, R. (2000). Economic and Social Costs of Crime. Great Britain Home Office Research Development and Statistics Directorate; Dubourg et al (2005) „The economic and social costs of crime against individuals and households 2003/04". Home Office Online Report 30/05. London: Home Office; Dossetor, K. (2011). Cost-Benefit Analysis and Its Application to Crime Prevention and Criminal Justice Research (https://www.ncjrs.gov/App/Publications/abstract.aspx?ID=256076).

[251] These estimates were the first estimates of crime costs in England and Wales.

[252] See, for example, Brand S. and Price R. (2000), '*The economic and social costs of crime*', Economics and Resource Analysis Research, Development and Statistics Directorate, Home Office, UK.

[253]http://www.eucpn.org/docs/review_costs_benefits_crime_prevention_en.pdf.

[254] For example: http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/493018/IPOL-JOIN_ET(2013)493018_EN.pdf; http://www.eucpn.org/docs/review_costs_benefits_crime_prevention_en.pdf.

3 and 4 Types of the Project may result in savins of time regarding shorter and smoother procedures

It is common to use the assesment of creation possibilities of lost production, e.g. valuation of the time where victim of the crime was absent from the job regarding participation in judicial proceedings[255].

5 and 6 Types of the Projects shows the investments into electronic service creation, development, increase in availability. According to 2008 guidelines of European Commission (Chapter 3.3.4 „Infrastructure of telecommunications“) benefit of such investment is related with savings of the time by using new or upgraded electronic services or with the intention to pay for new or upgraded services.

Detailed reasons for the choice of benefit (damage) components is provided in tabel 77.

Table 33. Choice of arguments of benefit (damage) components

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Decreasing of health impairments and deaths.	Direct influence	This benefit appears when performed investments into justice/ law enforcement sectors helps to prevent influence of crimes or to decrease such influence. Samples of projects performed in Lithuania includes investments into the equipment of expertise institutions, which is necessary for investigation of crimes and ensuring prevention of crimes. Implementation of prevention of crimes and measures of control helps to reduce crime rates and the risk of deaths and disruptions of health and in this way can be saved a lot of potential victims.
2. Decreasing of caused damage to the property	Direct influence	Similar to the above, the following benefit appears where it is financed projects consolidating crime prevention and control. The component of benefit shows the decreasing damage to the property in this case. National strategic provisions also shows such benefit, e.g. decreasing a number of repeated crimes commited by persons who are released to freedom / this sustainability is included into the scopes of 2013-2015 Stategical Plan of Activity which are managed by the Minister of Justice of the Republic of Lithuania[256].
3. Decreasing of negative emotional	Direct influence	Evidence of submitted literature [257] disclosure that victims of a crimes without material damage also suffer psychological distress. E.g. the victim may feel scare, insecurity, mistrust, vulnerability, fear of walking

[255]Cohen, M.A. (2000). Measuring the costs and benefits of crime and justice, in LaFree G, Measurement and analysis of crime and justice. Washington, DC: National Institute of Justice, US Department of Justice.

[257]See, for example, Brand S. and Price R., 2000, *The economic and social costs of crime*, Home Office Research Study 217, London, UK.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
influence		outside during hours of darkness even after more than one week after the robbery or theft[258].
4. Decreasing of public costs for administration of crimes	Direct influence	This benefit is related with the savings of costs of justice systems incurred by the administration of criminal offenses. Evidence of submitted literature disclosure that admisnitration of the crimes requires huge costs[259], including, e.g. costs of police for regitration and investigation of crimes, prison costs and etc. Decreasing of indicators of crimes for a long period promotes the savings of public resources and allows to use these savings in other areas.
5. Savings of time	Direct influence	In the science of economy it is common to use the assesment of creation possibilities of lost production, e.g. valuation of the time where victim of the crime was absent from the job regarding participation in the judicial proceedings, or valuation of the time where citizens are participating in the proceedings of the civil cases. Savings of the time will be determined by the influence of investments into accelerated or optimized judicial process and transfer of law enforcement services into electronic system. According to the 2008 guidelines of European Commission (Chapter 3.3.4 „Infrastructure of telecommunications“) this is one of two influence types regarding direct transfer of services into electronic system. This benefit is also significant and important in ACB (Analysis of Cost and Benefit) regarding Creation and Development of Projects of Electronic Services.
6. Savings on Cash Costs	Direct influence	This benefit shows the cash savings of users where they are using these services. This benefit appears, if new electronic services will be delivered (There are some examples of performed projects such as creation of registration service of legal entity (JAREP), creation of electronic services of justice process and etc. in Lithuania.). This benefit is also significant and important in ACB (Analysis of Cost and Benefit) regarding Creation and Development of Projects of Electronic Services.

[258] For example, Dubourg, R. et. al. ‘The economic and social costs of crime against individuals and households 2003/04’, Home Office Online Report 30/05, Research, Development and Statistics Directorate, Home Office, June 2005.

[259] For example, Administrative costs of crimes against individuals and households amounted to more than 7 billion pounds or 130 pounds in 2003 and 2004 in England and Wales. (http://webarchive.nationalarchives.gov.uk/20100413151441/http:/www.homeoffice.gov.uk/rds/pdfs05/rdsolr3005.pdf).

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
7. Better performance of information system	Direct influence	Better performance of information system- direct influence followed by investments into infrastructure which would move supplying of the present services into higher level of security, administration and accessibility. This influence will be indicated in three IS quality parameters: average time which user spends for completion of operation, trustability of IS which shows the capacity to provide services without interferences and security of data. Samples of performed projects in Lithuania include investment into IT security of the Centre of Registers and the Central Mortgage Office.

Source: concluded by BGI Consulting ir CSIL Milano.

It is provided benefit (damage) components implemented for special types of the projects in table of the Annex No. 1 of the Sector.

1.10.3. Calculation Methodology and Application Instructions

1. Reduction of Health Impairments and Deaths

Reduction of individuals of health Impairments and deaths is the directly main and very important benefit of interventions which has aim to reduce the number of the crimes and to ensure security of citizens.

Victims of the crime incur such social costs[260]: direct and indirect damage (damage) caused by criminal offense and psychological suffering.

Direct costs include medical expenses, including fees for hospital and medical services, also costs of emergency medical transport, rehabilitation, medical equipment, funeral expenses (in case of death) and other costs related with administration of allowance of insurance. The indirect costs of crime is related with damage for the society that victim becames unable to work and to create a product.

Quality of victim‘s life decreases due to suffer and pain, for example. the victim may feel scare, insecurity, mistrust, vulnerability, fear of walking outside during hours of darkness or to go to the workplace during daylight time even after more than one week after the robbery or theft.[261] (Component „3. Decreasing of negative emotional influence “ tells more about this)

[260]See, E.g, Brand S. and Price R., 2000, *The economic and social costs of crime*, Home Office Research Study 217, London, UK.

[261] E.g, Dubourg, R. et. al. ‘The economic and social costs of crime against individuals and households 2003/04’, Home Office Online Report 30/05, Research, Development and Statistics Directorate, Home Office, June 2005.

It was found the evidence that evaluation of reduction of the risk of health disruptions or death was based on estimate calculated for the transport sector in some countries for a long time. This evaluation of accident is expressed in a monetary value[262].

This benefit includes savings of medical costs and lost income of victim due to the accident.

Health impairments and death reduction, which was reached in connection with prevention of crimes, can be expressed in monetary value, as indicated in the methodology for transport sector related to the reduction in accidents (component „3. Decreasing of accidents").

Such monetary expression is used in sector for public security according to such values of costs providing prices in 2013 (Component „1. Decrease of health impairments and deaths"):

- **1,219,441 LTL death;**
- **174,577 LTL severe health impairment;**
- **11,735 LTL non-severe/negligible health impairment.**

Implementation of Component and Estimate in the Sector of Justice/ Law Enforcement

Implementattion Intructions of estimate of benefit component are the same as it is provided in chapter about sector for public security. Benefit component will be implemented even in this case, if project manager foresee that, for example, investment into long-term property of expertise institution will prevent further crimes and it will be avoided deaths or health impairment, or investment into prison infrastructure will reduce the number of repeated crimes comitted by persons who are released to freedom (or at least it will sustain the number of crimes).

The first step of estimate for decreasing health impairments and deaths is evaluation of every alternative of the project regarding completed investments which has purpose to reduce the number of health impairments and deaths.

Project manager with the respect of the nature of specific analysis of the investment, historical dynamics of health impairments and deaths, the scope of the planned investments and other relevant information, has to detect expected decreasing of health impairments and deaths in comparison with situation if project would not be implemented.

Expected decrease of number of health impairments and deaths must be evaluated by economic point of view expressed in monetary value.

2. Decrease of damage caused to property

The damage caused to property ar stolen property is direct and material costs of the victim of the crime.

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[262] See, E.g. Brand S. and Price R., 2000, *The economic and social costs of crime*, Home Office Research Study 217, London, UK.

In literature it is generally agreed on the need to secure the rights of property ownership and then the value of stolen/damaged property is deemed as social costs[263].

Indirect method of evaluation of social costs related to the damage made to property could be deemed as the estimation of lost resources in comparison with the value of changing stolen property or repair of broken property. Practically it is calculated according to allowance of insurance for the lost property or for the damage of the property.

Estimate of implemented benefit components compares with estimate of components provided in chapter about sector for public security (see component“2. Decrease of damage caused to the property“):

Table 34. Implemented estimates of damage caused to the property in Lithuania (LTL, prices in 2013)

Crime / Incident type	LTL
Private housing: theft / vandalism	1,800
Private housing: setting on fire	15,600
Commercial property: theft/vandalism	5,200
Commercial property: setting on fire	65,600
Private / commercial automobile: theft	26,700
Private / commercial automobile: vandalism	1,200

Source: concluded by BGI Consulting ir CSIL Milano.

Implementation of Component and Estimate in the Sector of Justice/ Law Enforcement

Implementattion Intructions of estimate of benefit component are the same as it is provided in chapter about sector for public security.

If it necessary to calculate the benefit of decrease of property crimes, estimate of component benefit will be multipled from the number of avoided crimes which was expected by the implementation of the project.

If this method is implemented, it must be evaluated the number of avoided crimes according to every type of the crime, because costs of repair and costs of changing the property varies from each other depending on the type of damage caused.

3. Decrease of negative emotional influence

Victims of the crimes can suffer variuos psychological disturbances, for example disquiet, avoidance behavior, especially staying at home during hours of darkness, sometimes victims go around long distances in order to avoid walking in certain streets and etc.

[263] See, for example, Cohen M.A., 2000, *Measuring the costs and benefits of crime and justice*, in Criminal Justice, Volume 4.

In order to evaluate the decrease of negative emotional influence it can be used method based on shadow prices.

The methodology of calculation is analogical to the component of benefit „3. Improved safety and quality of life“ provided in chapter about sector for public security. Shadow price of crime fear which is calculated for Lithuania shows that feeling insecure during walking time in own area is equal to 19,913 LTL for each household per year.

Implementation of Component and Estimate for the Sector of Justice/Law Enforcement

If it necessary to calculate the benefit of decrease of emotional influence, estimate of component benefit will be multipled from the number of households which probably will avoid negative emotional influence regarding the reduction of crimes.

Instructions of implementation of the component of benefit is analogical to sector „3. Improved safety and quality of life“ for public security.

4. Decreasing of Public Costs for Administartion of Crimes

Arguments submitted in literature confirms that various costs appear in response to the crimes[264]. This includes such costs as crime registration in police, investigation and collection of evidence and etc. as well as the costs of the courts, legal defence, prison and probation services.

National public sector provides the necessary resources for the administration of criminal offenses. If the criminal rates are decreasing, these resources would be saved and would be used in other areas or assigned to increase the efficiency of the criminal justice system (for example, for increasing of the number of investigated crimes with the the same quantities of resources).

In calculating this benefit should be considered, that crime administrative costs are fixed in the short term, it means that it does not depend on the number of committed or investigated crimes.

But criminality reduction saves the public costs for a long period or increases the efficiency of the criminal justice system.

Estimate of component of benefit are the same as provided in sector of public security (Component „4. Decreasing of public costs for administration of crimes“:

Table 35. Estimate of public costs for administration of one crime in Lithuania (Lt, prices in 2013)

Crime type	Costs for administration of one crime, LTL
Crimes agaist persons and households	
Murder	305,560

[264] Brand S. and Price R. (2000), ‘*The economic and social costs of crime*’, Economics and Resource Analysis Research, Development and Statistics Directorate, Home Office, UK.

Crime type	Costs for administration of one crime, LTL
Severe health impairment	30,389
Non-severe/negligible health impairment	2,072
Robbery	5,510
Theft by breaking into housing	2,409
Theft (not vehicle)[265]	638
Theft of vehicle	422
Damage caused by the crime (for example, setting on fire or vandalism)	267
Crimes against the property of subjects of business and public sector	
Theft by breaking not into housing	2,409
Theft of commercial vehicle	984
Robbery	5,510
Damage caused by the crime (for example, setting on fire or vandalism)	267

Sources: formed by BGI Consulting ir CSIL Milano according Brand S. and Price R., 2000, The economic and social costs of crime, Home Office Research Study 217, London, UK; Dubourg et al (2005) „The economic and social costs of crime against individuals and households 2003/04". Home Office Online Report 30/05. London: Home Office.

Implementation of Component and Estimate for the Sector of Justice/Law Enforcement

Implementattion Intructions of estimate of benefit component are the same as it is provided in chapter about sector for public security.

Reduction of benefits of public costs for administration of crimes will grant the effect for a longer period.

If it is necessary to calculate this benefit, attention will be paid to the number of crimes which must be avoided after implementation of the project.

This number must be multipled from unitary value which is mentioned in the table above.

5. Savings of Time

Savings of time depend on reconstructed infrastructure of institutions of justice/ law enforcement, which results shorter time for visitors, as well as the creation of new electronic services which will change services supplied in non-electronic way.

[265] It includes theft from individual, bike theft and etc.

Visitors can be divided into individuals who comes during working hours and individuals who comes during freetime.

Calculation of value of time are almost the same as it is provided in chapter for transport sector, except this, that it is not applicable an adjustment coefficient for sector of justice/ law enforcement, which shows that individuals who spend most for the transport mainly earn most.

That is why value of working time is applicable to justice/ law enforcement sector. This value of working time is calculated by prices of 2013 and is equal 19.30 LTL per hour, and the value of non-workig time is equal 7.72 LTL per hour.

These estimates are lower than estimates provided in chapter of transport sector, because the object of analysis of transport sector is users of the transport. Individuals who earn higher income more often uses transport. Meanwhile, all groups of citizens usually use physical and electronic services of justice / law enforcement institutions.

Implementation of Component and Estimate for the Sector of Justice/Law Enforcement

Implementattion Intructions of estimate of benefit component are analogical to instructions provided in the parts for sectors of transport and development of information society.

If it is nescessary to calculate the benefit which appears in the respect of savings of time, unitary value mentioned above must be multipled from the foreseen annual saving hours (separate working and non-working hours). This is how the value of the benefits received for a particular year due to the decrease of time costs incurred to use services of institutions of law enforcement.

Examples of benefit calculation are given following:

Insert 22. Calculations of time savings appeared from the reduction in services provided by the physical delivery time.

For example modernization of the building of law enforcement institution and acquired new equipment allows to shorten one customer service time in 10 minutes.

Let‘s say, historical data and demand analysis shows that it will be served 300,000 people every year.

In view of the service type, it is assumed that all service users can be served in their working time. Therefore, use of working time value is equal to 19.30 LTL per hour.

The annual benefit of the project for saving time cost is equal to:

$$300{,}000 * (10 / 60) * 19.30 = 965{,}000 \text{ LTL.}$$

Source: formed by BGI Consulting ir CSIL Milano.

Insert 23 Time savings calculations appeared from the creation of electronic access to services previously provided only in physical form.

Let‘s say, The analysis is performed due time cost savings appeared from the creation of electronic access to services of law enforcement authority previously provided only in physical form. Analysis has shown that 300,000 queries per year will be handled not physically but electronically from beginning to supply services in electronic form.

It is calculated that average time is 25 minutes that users actually reach the place of services supply and The average awaiting time is 20 minutes, which is spent for standing in the row in the actual service location.

According to submitted sample it is assumed that time would not be saved, if service supply operation would be performed electronically.

If average time saved for the trip regarding avoid the need to visit actual service supply location woud be added to saved time due to avoid the row at the actual service location as well as added saved time during the same provision of services operation, it would be give a total time savings which is equal to 45 minutes or 0.75 hours:

(25 min. + 20 min. + 0 min.) / 60 min. = 0.75 hour.

According to the type of the service it is assumed that 80 % of service users are enjoying the services during their working hours, the rest 20 % of users are enjoying non- working time (applicable to the corresponding 19.30 LTL per hour and 7.72 LTL per hour estimates.

The annual benefits of the project of electronic services for users regarding time savings cost is equal to:

300,000 * 0.75 * 0.8 * 19.30 + 300,000 * 0.75 * 0.2 * 7.72 = 3,821,400 LTL.

Source: formed by BGI Consulting ir CSIL Milano.

6. Savings of monetary costs

In addition to cost-savings time another important benefit which appears due to electronic access to services, which were supplied by non-electronic form is savings of monetary costs.

It is excluded two types of transport due to calculating the monetary value of the cost savings: the personal and the public.

It is worth to mention that the monetary cost of transport also includes rates and charges.

In the case of personal transport, it is necessary to take into account the vehicle exploitation costs (VOC) which is described as costs incurred by the user of vehicle during exploitation.

Calculation of exploitation costs of personal vehicle (VOC) are almost the same as it is described in chapter for transport sector, except that, sector of justice/ law enforcement VOC shows obligation to pay, that is why inderect rates are not eliminated from the value of VOC.

In case of sector of justice/ law enforcement applicable VOC value for automobiles is 0.83 LTL/km (charges are included) in Lithuania.[266]

If it is nescessary to get for one service user per vehicle exploitation costs VOC_n (Lt/km), VOC must be divided from average number of individuals who travels by automobiles. The number of individuals who travels by automobiles is 1.2 passenger for the automobile in Lithuania[267].

In the case where vehicle do not need fuel and oil (for example bike) or vehicle for travel is not necessary VOC is considered to be equal to 0.

Public transport users savings of monetary costs are tickets of public transport.

Implementation of Component and Estimate for the Sector of Justice/Law Enforcement

Implementattion Intructions of estimate of benefit component are analogical to instructions provided in the chapter for development of information society (component „1. Savings of time and monetary costs due to using electronic services instead of non-electronic services“).

Calculation of example is given in the insert below.

Insert 24 Time savings calculations appeared from the creation of electronic access to services previously provided only in physical form

Let‘s say The analysis is performed for situation provided in Insert No. 23 that 300,000 queries per year will be handled not physically but electronically from beginning to supply services in electronic form.

Analysis showed that structure of users of the service according to type of transport follows in such manner:

- Personal automobiles = 50 %,
- Public transport = 30 %,
- other (which does not require monetary costs) transport = 20 %.

It was found that the average distance saved by users is 15 km.

The exploitation costs for personal automobile applicable to vehicle exploitation costs is equal to 0.83 LTL for a kilometre (it is assumed that user of the service would drive alone)

Let‘s say that it would be spent average 4 LTL for public transport tickets.

The annual benefits of the project of electronic services for users regarding savings of monetary cost is equal to:

$$300,000 * 0.5 * 0.83 * 15 + 300,000 * 0.3 * 4 = 2,227,500 \text{ LTL}.$$

Source: formed by BGI Consulting ir CSIL Milano.

[266] According to provided information of Public enterprise Road and transport research institute.

[267] According to information of Public enterprise Road and transport research institute.

7. Better performance of information system

Improving of performance of information system (IS) means improving of quality parameters of electronic services, it means that present services will be tranfered into higher level of security, administration, administration, availability.

This analysis shows three quality parameters of IS: average time which user spends for completion of operation, trustability of IS which shows the capacity to provide services without interferences and security of data.

Better performance of IS is expressed by these parameters.

- average time which user spends for completion of operation, abbreviation (T_{oper}), expressed by hours for one operation,
- reduction of IS failure due to disruptions and maintenance time (T_{nev}), expressed, for example hours per year
- Increased integrity of data, which shows capacity of IS that data will be secured without any cahnges,
- Increased privacy of data, which means capacity of IS that it will be to prevented access to data for individuals without licence

Calculation of estimate of improving of every parameter are the same as the sector for development of information society (component „3. Better performance of information system“).

Implementation of Component and Estimate for the Sector of Justice/Law Enforcement

Implementattion Intructions of estimate of benefit component are analogical to instructions provided in the sector for development of information society (component „3. Better performance of information system“).

Application instructions are illustrated by the example in the insert.

Insert 25 Better performance of information system.

Sample No.1. Decrease of average time which user spends for completion of operation

Analysis of the project for the improving of electronic system.

It is calculated that it will be processed 1 million information requests per year, 60% of them will be performed during working time of service users, and 40% of them will be performed during non-working time of service users.

Acoording to technical data of the project it is calculated that it will be used less time in 30 seconds for each request (T_{oper} = 30 sec. = 0.0083 hour / operation).

Value of time for users who perform the search for the work purposes is equal to 19.30 LTL per hour. Meanwhile value of time for users who perform the search for the non-work purpose is equal to 7.72 LTL per hour.

Annual benefit appeared due to better performance of IS is equal:

1,000,000 * 0.60 * 0.0083 * 19.30 + 1,000,000 * 0.40 * 0.0083 * 7.72 = 121,744 LTL

<u>Sample No.2. Reduction of IS failure due to disruptions and maintenance time</u>

Analysis of project of reduction of electronic system failure time.

It is calculated that it will be processed 1,000,000 request per year, performing 1,000,000/8,760[268] = 114.2 operations per hour.

According to technical data of the project it is provided that failure time will decrease in 100 hours per year.

Let‘s say user has wish to pay 5 LTL for each operation.

Annual benefit appeared regarding to reduction of IS failure due to failure and maintenence time is equal:

100 * 114.2 * 5 = 57,100 LTL.

Source: formed by BGI Consulting ir CSIL Milano.

[268] 365 days * 24 hours = 8,760.

1.10.4. Table of estimates of social- economic influence for sector of Justice / Law Enforcement

Provided estimates of social- economic influence are specified in Technical task of the Table No. 80. According to requirements of Technical task, table of indicators must be related to conversion rates established by the service provider in order to ensure that it will not be overvaluation of benefit and damage of (double-counting). However, none of the established estimate is not related to the provided conversion rates which are applicable to the costs, that is why there is no risk of overvaluation between benefits and claims.

Table 36. Estimates of Social- Economic Influence Provided for Sector of Justice/Law Enforcement

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload (table of strong, reliable and significant ratings (at least three)</th><th>Quantitative expression, LTL</th></tr>
<tr><td>Justice / Law enforcement</td><td>N/a</td><td>N/a</td><td>1. Decreasing of health impairments and deaths.</td><td>1,219,441 LTL for death;
174,577 LTL for severe health impairment;
11,735 LTL non-severe/negligible health impairment.</td></tr>
<tr><td>Justice / Law enforcement</td><td>N/a</td><td>N/a</td><td>2. Decreasing of caused damage to the property</td><td>Implemented estimates of damage caused to the property:
<table>
<tr><th>Crime/Incident type</th><th>Lt</th></tr>
<tr><td>Private housing: theft / vandalism</td><td>1,800</td></tr>
<tr><td>Private housing: setting on fire</td><td>15,600</td></tr>
<tr><td>Commercial property: theft/vandalism</td><td>5,200</td></tr>
<tr><td>Commercial property: setting on fire</td><td>65,600</td></tr>
<tr><td>Theft of Private / commercial automobile</td><td>26,700</td></tr>
<tr><td>Private / commercial automobile: vandalism</td><td>1,200</td></tr>
</table></td></tr>
<tr><td>Justice / Law enforcement</td><td>N/a</td><td>N/a</td><td>3. Decreasing of negative emotional</td><td>Feeling unsafe : 19,913 LTL foro ne household per year</td></tr>
</table>

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload (table of strong, reliable and significant ratings (at least three)	Quantitative expression, LTL	
				Crime type	**Administration costs for one crime, LTL**
Justice / Law enforcement	N/a	N/a	4. Decreasing of public costs for administration of crimes	**Crimes agaist persons and households**	
				Murder	305,560
				Severe health impairment	30,389
				Non-severe/negligible health impairment	2,072
				Robbery	5,510
				Theft by breaking into housing	2,409
				Theft (not vehicle)[269]	638
				Theft of vehicle	422
				Damage caused by the crime (for example setting on fire or vandalism)	267
				Crimes against the property of subjects of business and public sector	
				Theft by breaking not into housing	2,409
				Theft of commercial vehicle	984
				Robbery	5,510
				Damage caused by the crime (for example, setting on fire or vandalism)	267
Justice / Law enforcement	N/a	N/a	5. Savings of time	Value of time (prices in 2013): • Working time: 19.30 LTL per hour. • Non- working time: 7.72 LTL per hour.	

[269] It includes theft from individual, bike theft and etc.

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload (table of strong, reliable and significant ratings (at least three)	Quantitative expression, LTL
Justice / Law enforcement	N/a	N/a	6. Savings of monetary costs	Applicable VOC value for automobiles: 0.83 LTL/km. Ticket price of public transport paid by consumers (provided according specified object).
Justice / Law enforcement	N/a	N/a	7. Better performance of information system	7.1. Decreasing of average time which user spends for completion of one operation: • Value of working time: 19.30 LTL per hour. • Value for non- working time: 7.72 LTL per hour. 7.2. Reduction of IS failure due to disruptions and maintenance time : • User's wish to pay for one operation (depends on specified object). 7.3. Increasing safety of data (avoided costs depends on specified object).

Remarks:

* Table of indicators must be related to conversion rates established by the service provider in order to ensure that it will not be overvaluation of benefit and damage of (double-counting).

1.10.5. Annexes (Sector of Justice/Law Enforcement)

Annex 1. Benefit (Damage) Components applicable to the Different Types of the Projects

Project type	Applicable benefit (damage) components*
1. Investments into buildings of imprisonment institution and their installation	1. Decreasing of health impairments and deaths. 2. Decreasing of caused damage to the property 3. Decreasing of negative emotional influence 4. Decreasing of public costs for administration of crimes
2. Investment into buildings and their installation of expertise institutions.	1. Decreasing of health impairments and deaths. 2. Decreasing of caused damage to the property 3. Decreasing of negative emotional influence 4. Decreasing of public costs for administration of crimes
3. Investment into court buildings and their installation.	1. Decreasing of health impairments and deaths. 2. Decreasing of caused damage to the property 3. Decreasing of negative emotional influence 4. Decreasing of public costs for administration of crimes 5. Savings of time
4. Investment into other buildings and their intallation of law enforcement institutions.	5. Savings of time
5. Investment into creation and development of electronic services oriented into the final user.	5. Savings of time 6. Savings on Cash Costs
6. Investment into infrastucture which would move supplying of the present services into higher level of security, administration and accessibility.	7. Better performance of information system

1.11. Public Security

1.11.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.11.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The choice of benefit (damage) components was based on the list of the approved general project types of public security sector (Table 81).

Table 37. Grouped types of the general projects of public security sectors

Project types	Project examples
1. Investments in the infrastructure, necessary for maintaining the public order, crime prevention and control	1.1. Car fleet renewal 1.2. The construction and reconstruction of the police station buildings 1.3. The acquisition of the police weapons and special means / special equipment 1.4. The development of information systems, departmental registers and information technologies 1.5. The development and modernization of material and technical base of the police stations
2. Investments in the infrastructure of fire safety and civil protection	2.1. The improvement of the structure of firefighting and special purpose vehicles fleet 2.2. The acquisition of the equipment and facilities for the State Fire and Rescue Services 2.3. The construction of the Firefighters Training School with the training ground
3. The investments in the infrastructure of the state border protection	3.1. The purchase of vehicles 3.2. The installation of the surveillance system for the cross-border point 3.3. The acqusition of technical control and surveillance measures
4. The investments in the infrastructure, necessary for the issuance of identity documents and the regulation of migration	4.1. The software update for the issue of identity documents 4.2. The acquisition of the documents examination equipment

The source: developed by BGI Consulting and CSIL Milano according to SFMIS, strategic planning documents and information, submitted by the Ministry of Interior of the Republic of Lithuania.

Security issues occupy an important place in the political agenda of many European countries, because a perception is widespread that malicious acts, including terror attacks are increasingly threatening security. Lithuania also focus on crime prevention[270].

Literature [271] contains evidence that show that regardless of the type, crime leads to huge costs to society. Effective crime reduction measures may create very large personal, household, business and public sector savings. For example, in England and Wales, the annual cost of crime, provided in recent studies, estimate from 35 to 60 billion British pounds[272] or from 600 to 1,100 pounds per capita. Some studies mention even larger numbers, for example it was estimated that in Manchester (England), the annual costs of crime per capita are 2,295 pounds [273].

However, it is important to emphasize that general, typical projects of public security focus not only on the investments for the prevention of crimes (for example, murders, damage to people or property, thefts, etc.) and on their reduction, but also include the investments to ensure public security, including, for example fire prevention measures and mitigate their risks.

The benefits provided by the investments into the infrastructure of public security are reflected by the following benefit components:

- The reduction of bodily injuries and deaths;
- The reduction of damage to property;
- Improved safety and quality of life;
- The reduction of public costs for crime administration;

The detailed justification of the choice of the benefit (damage) components is presented in Table 82.

Table 38. The arguments of the choice of the benefit (damage) components

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. The reduction of bodily injuries and deaths	Direct effects	This benefit occurs when the new infrastructure is developed, technologies implemented and / or equipment for the prevention or reduction of the effects of : i) fires and ii) crimes. The examples of the projects, implemented in Lithuania include the investments to the improvement of the fleets of firefighting and other special vehicles and the infrastructure, necessary for the ensuring of public order and crime prevention. The application of crime and fire prevention and control measures allows to reduce crime indexes and the risks of the deaths

[270] For example, National Crime Prevention and Control program was approved and has been implemented.
[271] For example: http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/493018/IPOL-JOIN_ET(2013)493018_EN.pdf; http://www.eucpn.org/docs/review_costs_benefits_crime_prevention_en.pdf.
[272] For example, see Brand S. and Price R. (2000), '*The economic and social costs of crime*', Economics and Resource Analysis Research, Development and Statistics Directorate, Home Office, UK.
[273]http://www.eucpn.org/docs/review_costs_benefits_crime_prevention_en.pdf.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		and bodily injuries, thus saving a lot of potential victims.
2. The reduction of damage to property	Direct effects	Similarly as the above-mentioned, this benefit arises when the financed projects increase the prevention and control of crime and fire and ensure a rapid response of the police or civil security services. The experience of the projects implemented in Lithuania testifies about the investments for the increase in the work efficiency of the police, to ensure a rapid response to emergency calls, to increase the number of residents, receiving warnings of natural disasters.
3. Improved safety and quality of life	Dirrect effects	The evidence, presented in literature [274] reveal that the police buildings in the neighbourhood, rapid and effective rescue services, the increased control of the regulation of migration, and identity documents contributes to the safety of the area and in turn to its attractiveness to the population and improves their quality of life. Also the evidence[275] presented in literature reveal that crime victims feel psychological distress next to pecuniary damage. For example, even after several weeks after the robbery or theft, the victim can feel fear, insecurity, mistrust and vulnerability, may be afraid to go outdoors during the hours of darkness[276].
4. The reduction of public costs for crime administration	Direct effect	This benefit is accociated with the savings of the justice system costs, incurred when administering crimes. The evidence, presented in literature, reveal that crime administration requires enormous costs[277], for example, including the costs, incurred by the police when registering, investigating crimes, prison expenses, etc. The reduction of crime rate in the long term promotes savings of public resources and allow to use the freed resources elsewhere.

The sources: developed by BGI Consulting and CSIL Milano.

[274] For example, see, Buonanno P., Montolio D., Raya-Vilchez J.M., 2012, *Housing prices and crime perception*, in Empirical Economics, Journal of the Institute for Advanced Studies, Vienna, Austria; Cohen M.A

[275]For example, see, Brand S. and Price R., 2000, *The economic and social costs of crime*, Home Office Research Study 217, London, UK.

[276] For example, Dubourg, R. et. al. 'The economic and social costs of crime against individuals and households 2003/04', Home Office Online Report 30/05, Research, Development and Statistics Directorate, Home Office, June 2005.

[277] For example, in 2003-2004, in England and Wales, the adminsitration cost of crimes against individuals and households was more than 7 billion pounds or 130 pounds per capita (http://webarchive.nationalarchives.gov.uk/20100413151441/http:/www.homeoffice.gov.uk/rds/pdfs05/rdsolr3005.pdf).

Table presented in Annex 1 sets out the benefits (damage) components, applicable to concrete types of projects.

1.11.3. Calculation Methodology and Application Instructions

1. The reduction of bodily injuries and deaths

The reduction of personal body injuries and deaths is especially important and the main direct benefit of interventions aimed at reducing crime rates and ensuring the security of citizens.

Crime victims face the following social costs[278]: direct and indirect damage (damage), caused by the damage and psychological distress.

Direct costs include medical costs, including the cost for hospital and medical care, also – the costs of emergency medical transport, rehabilitation, medical equipment, funeral (in case of death) and related insurance contribution costs. Indirect costs of crime, in turn, are related to the damage of created product, incurred by the public because of the victim‘s inability to work.

The pain and suffering cause the decrease of quality of victim‘s life, for example, even after several weeks after the robbery or the theft, the victim can feel fear, insecurity, mistrust and vulnerabilty, may be afraid to go outdoors during the hours of darkness or even to go into the workplace during daylight[279] (more is discussed below in the section on the improved security and quality of life).

One way to calculate the benefit of the reduction of bodily injuries or death risks is to directly ask people about their willingness to pay for the reduction of bodily injuries or death risks or about their willingness to accept the increased risk [280]. However, there are evidence that for a long time some countries have transport sector estimated values that give monetary value to the benefit of the reduction of accidents [281]. This benefit includes medical cost savings and avoided income loss of the potential victim.

Therefore, the monetary value may be attributed to the reduction of bodily injuries and deaths, achieved due to the crime prevention, on the basis of the methodics, presented in the section of transport sector, related to the reduction of accidents (component “3. The reduction of accidents“).

Calculation methodology and calculated estimate value

The basis of calculation – the statistical value of life (SVL)[282], which the economic literature describes as the amount which in the public point of view would be economically effective to spend on the saving of an

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[278]For example, see, Brand S. and Price R., 2000, *The economic and social costs of crime*, Home Office Research Study 217, London, UK.

[279] For example, Dubourg, R. et. al. ‘The economic and social costs of crime against individuals and households 2003/04’, Home Office Online Report 30/05, Research, Development and Statistics Directorate, Home Office, June 2005.

[280] This is a method of expressed preferences, which is more described to health care sector section.

[281] For example, Brand S. and Price R., 2000, *The economic and social costs of crime*, Home Office Research Study 217, London, UK.

[282] The term of „Statistical life“ is used considering the fact that most security measures aim at the reduction of death, but not to avoid conrete death. See Abelson P. (2010), The Value of Life and Health for Public Policy, Macquarie University, http://www.appliedeconomics.com.au/pubs/papers/pa03_health.htm.

unnamed person‘s life[283]. SVL calculations are presented in the section of health care. (component „1. The statistical value of life (SVL)“). Calculated by the human capital method, **calculated to Lithuania SVL is 990,047 LTL.**

In order to calculate the costs of bodily injuries, the calculation methodics of the costs of severe and light injurries, applicable to the section for transport sector (component “3. The reduction of accidents“). The values of bodily injuries and deaths in prices of 2013 are like this in Lithuania:

- **1,219,441 LTL for death;**
- **174,577 LTL for severe bodily injury;**
- **11,735 LTL for easy / minor bodily injury**

Comparison with other countries. The statistical value of life (SVL) is determined by the income of the population, therefore the SVL and accordingly the values of the costs of bodily injuries and deaths in analysed countries (France, Germany, Italy, Spain and the United Kingdom) are remarkably higher than the values, calculated in Lithuania.

Application instructions

The first step of the reduction of bodily injuries and deaths – in the case of every alternative of each project, to evaluate the number of avoided bodily injuries and deaths due to the investments to the public infrastructure.

Considering the nature of concrete analyzed investments, historical dynamics of bodily injuries and deaths, the extent of planned investments and other relevant information, the project coordinator should determine the expected reduction of bodily injuries and deaths in comparison with the scenario without the implementation of the project. The estimated reduction of bodily injuries and deaths should be seen in economical attitude by assigning a monetary value.

Estimate update instructions

The instruction of benefit component estimate values are analogous to the case of transport sector.

2. The reduction of damage to property

Damage to property or stolen property are direct and material costs of the victim of the crime. There is a common agreement in literature regarding the need to ensure the rights of property ownership and then consider the value of the stolen / damaged property in social costs [284].

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[283] See Björn Sund (2010), *Economic evaluation, value of life, stated preference methodology and determinants of risks*, Örebro Studies in Economics 21, Örebro University. OECD (2012), *Mortality Risk Valuation in Environment, Health and Transport Policies*, OECD Publishing. http://dx.doi.org/10.1787/9789264130807-en.

[284] For example, Cohen M.A., 2000, *Measuring the costs and benefits of crime and justice*, in Criminal Justice, Volume 4.

Calculation methodology and calculated estimate value

One of the ways to determine the benefit to the damage, done to the property, is to ask the victims of crime (fire) about the value of the stolen or damaged property. Surely, it should be borne in mind that such value changes depending on the type of crime (accident) (for example, theft, arson / fire, vandalism, etc.)

An indirect method to evaluate the social costs, related to the damage to property, is to rely on the value of the replacement of the stolen property or the damaged property as the estimate of the lost resources. In practice it is relied on the insurance contributions received for the lost property or damage done to it.

In order to determine the estimates of damage to property, applicabe to Lithuania, it was based on insurance contributions, paid by insurance companies for the most widespread types of crime / insurance events (as presented in Table 83 below). Then it was estimated the average value, submitted in the prices of 2013. The study methodology, on the basis of which the estimates of damage, done to the property is presented in Annex 2 of the sector.

Table 39. Lithuanian applicable estimates, done to property (in LTL, prices of 2013).

Crime / Incident type	LTL
Private housing: theft / vandalism	1,800
Private housing: fire	15,600
Commercial property: theft / vandalism	5,200
Commercial property: fire	65,600
The theft of private / commercial light vehicle	26,700
Private / commercial light vehicle: vandalism	1,200

The source: developed by BGI Consulting and CSIL Milano

Application instructions

In order to calculate the benefit of the reduction of the property targeted crimes or fires, the estimates, presented in Table 39 must be multiplied by the number of crimes (fires), expected to be prevented because of the implementation of the project. When applying this method, the number of prevented crimes (incidents) should be evaluated separately according to the type of each crime (incident), because the costs of property replacement or repairs vary depending on the type of damage.

Estimate update instructions

In the future year of the analysis period, it is recommended to increase the estimates of benefit component according to real increase in the GDP per capita, published by the International Monetary Fund[285]. The values, applicable to the first years of analysis period are recommended to update considering the nominal growth of the GDP per capita, and in order to update the estimates, the surveys of insurance policies or their associated structures could be carried out every five years.

3. Improved safety and quality of life

There are studies suggesting that crime and more generally, the low level of public security negatively affects quality of life[286]. Victims may experience various psychological disorders, such as anxiety or avoidance behavior, when it is aimed to stay at home during the hours of darkness, they walk very long distances in order to avoid walking in certain streets, etc. In literature[287] there exist certain concensus that persons take decisions about the place to live, establish new businesses or socialize on the basis of their perception of the security of various cities or regions.

Calculation methodology and calculated estimate value

Monetary value of life in safe environment may be determined by ascertaining the determination of society to pay for life in a safer district, which is reflected in real estate value[288]. The main assumption is the fact that high crime rate and, in a wider sense, low level of security in certain territories are understood as harmful, therefore persons are not interested to acquire a real estate in such territories. Such behavior, in turn, is reflected in the market prices of the real estate. It is expected that less safe regions will have lower housing prices, when the other factors, that may influence housing prices, are equal.

As a result, real estate prices in areas with low crime level (i.e. it is disclosed the preference of potential victims to live in the territories of lower crime level) can help to determine the perceived value of life quality in this territory. For this purpose, hedonic pricing method is applied. In order to assess such a method, the following formula is applied:

$$B = \sum_i N_i * V_i * \Delta_i\%$$

Where *i* is a type of real property, *N* – real estate *i* quantity; *V* – an average value of real estate *i*; Δ% - percentage increase in real estate, caused by the project.

The result (B) is an increase in real estate because of the implemented project, contributing to the decrease of crime.

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[285] The source: http://www.imf.org/external/ns/cs.aspx?id=28 (in national currency). TVF prognosis does not include all period of economic analysis, so considering arising uncertainties, the annual growth rate for the remaining period is calculated as an average of annual GDP growth rate per capita recent five years of prognosis.

[286] For example, Cohen M.A., 2000, *Measuring the costs and benefits of crime and justice*, in Criminal Justice, Volume 4; Brand S. and Price R., 2000, *The economic and social costs of crime*, Home Office Research Study 217, London, UK; Gilbertson J., Green G., Ormandy D. 2006, *Decent Homes, Better Health*, Sheffield Decent Homes, Health Impact Assessment.

[287] For example: http://www.popcenter.org/library/reading/pdfs/ReducingFearGuide.pdf; http://www.coginta.org/uploads/documents/2ba342d854f029fbf2ca6105add54c6fda5bb170.pdf.

[288] For example, see Buonanno P., Montolio D., Raya-Vilchez J.M., 2012, *Housing prices and crime perception*, in Empirical Economics, Journal of the Institute for Advanced Studies, Vienna, Austria; Cohen M.A., 2000, *Measuring the costs and benefits of crime and justice*, in Criminal Justice, Volume 4.

As an alternative, a method can be used, based on shadow prices, assigning a monetary value for life or business development in a safe region. In literature, there are examples of the application of this approach. Here S. Moore[289], on the basis of the data of European social study, calculated the shadow price of crime fear. The calculated value [290], in the prices of 2003 is equal to 9,400 British pounds of household income, reflects the assignment of the value to feeling "very" insecure after it gets dark and walking alone in the area.

This value can be assigned to Lithuania as a reference, because it reflects European level data. This value was applied to Lithuanian context through the transfer of benefit method. The application of such method included the transfer of the values, calculated for the United Kingdom, to Lithuanian context, using correctional measures (correctional coefficient). In many studies[291] it is suggested to use as a coefficient the ratio [292] of the GDP per capita of the "target" country and the GDP per capita of the "origin" country. The values calculated for the United Kingdom were multiplied by this ratio and recalculated to the prices of 2013.

The value, calculated for Lithuania is equal to **19,913 LTL to one household per year.**

Application instructions

It should be noted that the determined value of the benefit component reflects the value of maximum change feeling very insecure and very secure. If the investments of the project determine only partial improvement of safety situation, correspondingly only the proportional part of the calculated benefit component estimate value should be taken. When the partial safety situation improves, it is recommended to apply "Likert Scale" of 5 meanings (the difference between the nearest values would be equal 25 % of the estimate value): feeling very insecure; sufficiently insecure; neither secure, nor insecure; secure enough, very secure.

In order to calculate the benefit of the improved safety and quality of life, the suggested estimate value of the benefit component should be multiplied by the households, which, as expected, will benefit from the number of the increased safety and also the improved quality of life (or will avoid the emotional impact due to the reduced crime).

When the project determines the increase in security in a given area, usually the beneficial households are considered to be the households, residing in the target territory of the project.

When the benefit is related to the avoidance of negative emotional impact of potential victims due to the reduced crime, the project coordinator must foresee the time period the potential victims would have felt negative emotional impact, as it was specified in the example, provided below:

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[289]Moore S. (2006), *The value of reducing fear: an analysis using the European Social Survey*. Applied Economics, 38.

[290] Presented by Tyler P. et all, 2010, *Valuing the Benefits of Regeneration*, Department for Communities of Local Government, Economics paper 7: Volume 1 – Final report.

[291] For example, see Cropper M. L., Sahin S. (2009), V*aluing Mortality and Morbidity in the Context of Disaster Risks*, Policy Research Working Paper 4832, The World Bank - Development Research Group Sustainable Rural and Urban Development Team; Zhang, X. (2002), *Valuing Mortality Risk Reductions Using the Contingent Valuation Method: Evidence from A Survey of Beijing Residents in 1999,* prepared For the Second World Congress of Environmental Economist; Figueroa E. B. and Pasten R. C., 2010, *Improving Benefit Transfer for Wetland Valuation: Income Adjustment and Economic Values of Ecosystem Goods and Services,* Waddenacademie, Netherlands.

[292] In order to appropriately compare two states, the index of the nominal GDP per capita, submitted by Eurostat, is used.

Insert 26. The example of the improved safety and quality of life component estimate application

Suppose, the project coordinator expects that due to the implemented investments, during burglaries 20 thefts will be prevented in a year.

In addition to the reduction of the damage to property and the reduction of public costs for crime administration, the reduction of negative emotional impact is estimated.

Suppose, expert valuation showed that after burglary, an average potential victim would feel "insecurely enough" and such negative impact would continue for 1 month. Suppose, expert valuation also showed that an average potential victim in a usual state averagely feels "neither secure, nor insecure". The variation between these states reflect 25 % estimate values. Therefore, the benefit for one prevented theft is equal:

19,913 LTL for one household a year* (1 / 12 months) * 0.25 = 414.8

5 LTL.

Annual benefit would be equal:

20 thefts*412.75 LTL = 8,297 LTL.

The source: developed by BGI Consulting and CSIL Milano.

Estimate update instructions

In the future year of the analysis period it is recommended to increase the estimate value of benefit component according to the growth of the real GDP per capita, published by the International Monetary Fund. For the first year of the analysis it is recommended to update applicable value considering the growth of the nominal GDP per capita.

4. The reduction of public costs for crime administration

The arguments provided in literature confirm that in response to crimes various costs[293]. are incurred. These costs include crime records, carried out by the police, their investigation, the collection of evidences about them and other costs, also the costs of the courts, judicial defence and prisons and probation services.

The resourse, necessary for crime administration are given by the national governmental sector. While the indexes of crime decrease, these resources are released and may be used elsewhere or assigned for the increase in the efficiency of criminal justice system (for example, for the increase in the part of clarified crimes, using the same quantity of resources). Calculating this benefit, it must be borne in mind that the costs of crime administration are constant in the short period, i.e. they do not depend on the number of committed or investigated crimes. However, in the long term the reduction of crimes results in the savings of public costs or the increase in the efficiency of criminal justice system.

It should be noted that the number of registered crimes does not reflect actual number of committed crimes. In fact, the police can register only these crimes about which they received information. In addition,

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[293] Brand S. and Price R. (2000), '*The economic and social costs of crime*', Economics and Resource Analysis Research, Development and Statistics Directorate, Home Office, UK.

some crimes about which it was reported may be not registered, because, for example, there may be the lack of evidence that such crimes were comitted at all[294] (for details, see Annex 3 of the sector).

Calculation methodology and calculated estimate value

In order to calculate the benefit of the reduction of public costs for crime administration, it is necessary to determine the costs of crime administration, incurred by the national governmental sector. If there is a lack of official national data about such costs, it is usual to rely on the values, presented in literature. In 1999 the studies[295]of the costs of the crime administration, incurred by the criminal justice system of the United Kingdom were carried out. In this context, criminal justice system included the police, courts of various levels, legal assisstance, probation services, prisons and other elements. The calculations were carried out separately for each type of the crime. The determined estimates of the costs in the United Kingdom are widely used and updated. Other countries of the EU, for example Germany[296] rely on the estimates of the United Kingdom in their calculations.

There is a reason to believe that there is no significant difference among the systems of criminal justice of the EU, therefore the estimates, calculated to the United Kingdom, were transferred to Lithuanian context through benefit transfer method. When transferring values to Lithuanian context, it was based on the ratio of the nominal GDP per capita. In the table presented below there are the estimates applicable for Lithuania, converted to the prices of 2013.

Table 40. The values (in LTL in the prices of 2013) of public costs for the administration of one crime, applicable to Lithuania.

Crime type	The costs of one crime administration in LTL
Crimes against individuals and households	
Murder	305,560
Serious bodily injury	30,389
Mild / minor bodily injury	2,072
Robbery	5,510
Burglary	2,409
Theft (non-vehicle)[297]	638

[294] Brand S. and Price R. (2000), '*The economic and social costs of crime*', Economics and Resource Analysis Research, Development and Statistics Directorate, Home Office, UK.

[295]Brand S. and Price R., 2000, *The economic and social costs of crime*, Home Office Research Study 217, London, UK.

[296] For example: http://www.bertelsmann-stiftung.de/cps/rde/xbcr/SID-049B7004-CB104567/bst_engl/xcms_bst_dms_33066_33870_2.pdf.

[297] It includes a theft from a person, a bicycle theft, etc.

Crime type	The costs of one crime administration in LTL
Vehicle theft	422
The damage done by a crime (for example, an arson or a vandalism)	267
Crimes, targeted to the property of business and public sector entities	
Theft without breaking into a house	2,409
Commercial vehicle theft	984
Robbery	5,510
The damage, done by a crime (for example, an arson or a vandalism)	267

The source: developed by BGI Consulting and CSIL Milano, on the basis of Brand S. and Price R., 2000, The economic and social costs of crime, Home Office Research Study 217, London, UK; Dubourg et al (2005) „The economic and social costs of crime against individuals and households 2003/04 ". Home Office Online Report 30/05. London: Home Office.

Application instructions

As already mentioned, the benefit of the reduction of public costs for crime administration should materialize in the long term. In order to calculate it, it is useful to pay attention to the number of prevented crimes, expected to achieve due to the implementation of the project. This number should be multiplied by the unit value in the above table. The calculation example is presented below.

Insaert 27. The example of calculation of the reduction of the public costs for crime administration

For example, the analysis of the reduction of the criminal justice system costs, related to the crimes against individuals and households is carried out. On the basis of the above Table 40, an average amount of the public costs for the administration of one murder is 304,004 LTL. According to the data, submitted by Eurostat[298], it is known that 23 murders were committed in Vilnius in 2012. Suppose, an expert evaluation showed that the number of murders will decrease by 20 % due to the implementation of the project. Thus, the annual amount of public costs for crime administration will decrease 305,560* 0.2 * 23 = 1,405,576 LTL.

The source: developed by BGI Consulting and CSIL Milano.

[298] Crimes, registered by the police: murders in cities. See http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=crim_hom_city&lang=en (index code: crim_hom_city).

Estimate update instructions

In the future year of the analysis period, it is recommended to increase the values of estimates of benefit component according to the growth of the real GDP per capita, published by the International Monetary Fund. It is recommended to update the values, applicable for the first year of analysis, considering the growth of the nominal GDP per capita.

1.11.4. The estimates of socio-economic impact of the public protection sector

To sum up, the determined estimates of socio-economic impacts are presented in Technical Task by the specified form of a table (Table 85). According to the requirements of Technical Task, the table of indexes must be related to the conversion coefficients, specified by the service provider in order to ensure that there will be no double-counting in calculation. However, none of the established estimates is connected with the conversion coefficients, applicable to the costs, therefore there is no risk of double-counting.

Table 41. The estimates of socio-economic impact for the public security sector

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload (table of strong, reliable and significant ratings (at least three)</th><th>Quantitative expression, LTL (in the prices of 2013)</th></tr>
<tr><td>Public security</td><td>N/a</td><td>N/a</td><td>1. The reduction of bodily injuries and deaths</td><td>1,219,441 LTL for death;
174,577 LTL for serious bodily injuries;
11,735 LTL for easy / minor bodily injuries.</td></tr>
<tr><td>Public security</td><td>N/a</td><td>N/a</td><td>2. The reduction of the damage to property</td><td>The applicable estimates of damage to property:
<table>
<tr><th>Crime / Incident type</th><th>LTL</th></tr>
<tr><td>Private housing: theft / vandalism</td><td>1,800</td></tr>
<tr><td>Private housing: fire</td><td>15,600</td></tr>
<tr><td>Commercial property: theft / vandalism</td><td>5,200</td></tr>
<tr><td>Commercial property: fire</td><td>65,600</td></tr>
<tr><td>The theft of private / commercial light vehicle</td><td>26,700</td></tr>
<tr><td>Private / commercial light vehicle: vandalism</td><td>1,200</td></tr>
</table></td></tr>
<tr><td>Public security</td><td>N/a</td><td>N/a</td><td>3. Improved security and quality of life</td><td>Feeling secure: 19,913 LTL for one household a year</td></tr>
</table>

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload (table of strong, reliable and significant ratings (at least three)</th><th>Quantitative expression, LTL (in the prices of 2013)</th></tr>
<tr><td>Public security</td><td>N/a</td><td>N/a</td><td>4. The reduction of public costs for crime administration</td><td>
<table>
<tr><th>Crime type</th><th>The costs in LTL of one crime administration</th></tr>
<tr><td colspan="2">Crimes against individuals and households</td></tr>
<tr><td>Murder</td><td>305,560</td></tr>
<tr><td>Serious bodily injury</td><td>30,389</td></tr>
<tr><td>Easy / minor bodily injury</td><td>2,072</td></tr>
<tr><td>Robbery</td><td>5,510</td></tr>
<tr><td>Burglary</td><td>2,409</td></tr>
<tr><td>Theft (non-vehicle)[299]</td><td>638</td></tr>
<tr><td>The theft of a vehicle</td><td>422</td></tr>
<tr><td>Damage, done by a crime (for example, arson or vandalism)</td><td>267</td></tr>
<tr><td colspan="2">Crimes, targeted to property of business and public sector entities</td></tr>
<tr><td>Non-housing burglary</td><td>2,409</td></tr>
<tr><td>The theft of commercial vehicle</td><td>984</td></tr>
<tr><td>Robbery</td><td>5,510</td></tr>
<tr><td>Damage, done by a crime (for example, arson or vandalism)</td><td>267</td></tr>
</table>
</td></tr>
</table>

Comments:

* The table of indexes must be related to the conversion coefficients, established by the provider of services in order to ensure that there will not be double-counting in calculation.

[299] It includes the theft from a person, bicycle theft, etc.

1.11.5. Annexes (public security sector)

Annex 1. Benefit (damage) component, applicable to different project types

Project type	Applicable benefit (damage) components
1. Investment in the infrastructure, necessary for maintaining public order, crime prevention and control.	1. The reduction of bodily injuries and deaths 2. The reduction of damage to property 3. Improved security and quality of life 4. The reduction of public costs for crime administration
2. Investment in fire and civil protection infrastructure	1. The reduction of bodily injuries and deaths 2. The reduction of damage to property 3. Improved safety and quality of life (applicable only in the case of an obvious connection between the project results and impact (benefit (damage) component) 4. The reduction of public costs for crime administration (applicable only in the case of an obvious connection between the project results and impact (benefit (damage) component)
3. Investment in the infrastructure of border protection	1. The reduction of bodily injuries and deaths 2. The reduction of damage to property 3. Improved security and quality of life 4. The reduction of public costs for crime administration
4. Investments in the infrastructure, necessary for the issue of personal documents and the regulation of migration	1. The reduction of bodily injuries and deaths 2. The reduction of damage to property 3. Improved security and quality of life 4. The reduction of public costs for crime administration

Annex 2. The description of the main provisions of calculation of the estimates of benefit (damage) component "2. The reduction of damage to property"

The component of the reduction of the damage to property is distinguished in the public security and justice / law enforcement sectors. In order to calculate the estimate values of this benefit (damage) component it has been chosen to evaluate the costs, related to the damage to property, i.e. to rely on the value of the replacement of the stolen property or the value of the repair of damaged property as an estimate of lost resources. Objectively, it is based on average values of insurance contributions, received for the lost property or the damage done to it.

When performing the calculations of this benefit (damage) component, firstly, the most common types of crimes or incidents were identified and classified. According to the types of criminal activities / incidents, a typical object of the incident or activity impact was identified, in regard to which the damage is done or the material loss of other scope. According to the types and typical objects of criminal activity, in regard to which the damage is done, the written requests were formed for the insurance companies, occupying a significant part of the market and the association, uniting insurance companies. In order to ascertain the questions posed on the implementation of qualitative parameters, by the separate order it was communicated verbally (for example, it is clarified, what exactly is required, questioned, how the data will be processed and submitted).

The estimates of the damage done to the property, applicable to Lithuania, were calculated according to the data, submitted by the listed insurance companies and the association, unifying insurance companies, which, according to the assertion of these entities, are in compliance with the average values of the contributions for the damage done to the property of the last year (2013 / 2012, depending on the object).

In order to recalculate the estimate values, it is recommended to apply to the insurance companies, occupying a significant part of the market and to the associations, unifying them. On the basis of the calculation practice, which is based on strict statistical methods, of the risk evaluation of insurance companies and the pricing for insurance events, the authors of the methodics, trust the certainty and reliability of the data, submitted by these entities.

Annex 3. Demand analysis

In order to evaluate the investments of the public security sector, when carrying out the demand analysis, certain challenges are faced. The main element of the analysis – the number of prevented crimes, planned through the project implementation. However, in order to determine it, first of all it is necessary to evaluate the real number of committed crimes.

The literature of this field suggests to base on both the results of the victim's surveys, and the statistics of the police[300]. The statistics, provided by only the police, cannot give the full picture, because not all crimes are reported to the police. Therefore, the results of the surveys of the victims of the crimes are very important in order to fill the gaps in the statistics, collected by the police. The results of such surveys provide information about the crimes, perceived by the public and the part of the crimes, reported to the police in the total number of committed crimes.

One way to adjust the statistics of the police is to apply a coefficient, reflecting the ratio between the number of crimes, established during the surveys of the victims of the crimes and the number of crimes, registered by the police. For example, if the statistics of the police would show 20 thousand thefts, commited during certain time in the state, and at national level the results of the surveys of the victims of the committed crimes – 60 thousand thefts during the same time, in this case the coefficient would be equal 3. This coefficient could be used when adjusting the number of crimes, reported to the police.

When the surveys are not carried out on the national or regional level, it is possible to rely on the results of the international investigation of the victims of crimes, presenting the part of crimes, reported to the police (according to the crimes and states)[301].

[300] See Paul van Soomeren and Wever J., 2004, *A Review of Costs and Benefits Analysis in Crime Prevention in the EU Member States*, Report to the European Commission, Directorate-General for Justice, Freedom and Security.

[301] http://www.unicri.it/services/library_documentation/publications/icvs/

1.12. Tourism

1.12.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.12.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The selection of components of socio-economic impact (benefit and damage) was based on the list of the approved common project types of tourism sector (Table **Error! Reference source not found.**).

Table 86 . Common project types of tourism sector

Project type	Project examples
1. Investment in adjusting public nature objects located on tourist routes to the needs of sustainable tourism	1.1. Creation of bicycle and water tourism routes, reforestation, administration of coastal areas and so on
2. Investment in adjusting cultural heritage objects located on tourist routes to the needs of sustainable tourism	2.1. Creation of infrastructure of cultural heritage objects

Source: compiled by BGI Consulting and CSIL Milano according to SFMIS, strategic planning documents and information submitted by the Ministry of Economy of the Republic of Lithuania.

As stated in the guidelines of EC 2008, evaluation of projects' benefits to tourism sector is usually based on WTP for a tourist attraction – a museum, an archaeological park and so on. The expected increase in tourism sector's income can also be evaluated (increasing visitors' flow and their length of stay). Costs of increasing transport flows can be considered as additional costs to tourism.

WTP can be evaluated by several methods. To evaluate an individual object, a contingent valuation method can be used: in order to identify the value of that object, the sample of population is interviewed and conclusions about the entire population are drawn based on the results. Also in this case, the benefit transfer approach can be applied when it is reffered to evaluation of the similar object (evaluation of the similar object is adjusted according to technical, socio-economic, geographical, and time-related features of a project in consideration to get valid evaluation for it). However, individual projects may be different so in order to identify applicable values of social and socio-economic impact estimates for tourism sector a more common approach is necessary. For this reason it might be handy to use data collected by the Lithuanian Department of Statistics on the costs of same-day visitors and tourists, i.e. it is suggested to evaluate visitors' WTP for tourist attractions by the method of travel costs which reflects how much visitors have to spend to be able to visit a particular object. As various groups of visitors differ in their behavior and amounts of money they spend, it is useful to identify socio-economic impact estimates to more than one group of visitors. Four groups of visitors can be distinguished according to the commonly used classification[302] of visitors:

- Local same-day visitors, i.e. local visitors[303], who do not stay overnight. Benefit component would reflect the average costs of a trip a same-day visitor spends on;
- Local tourists, i.e. local tourists who stay at least for one night. Benefit component would reflect the average daily expenditure of such a visitor;
- Non-resident same-day visitors, i.e. visitors from abroad who do not stay overnight in any collective or private accommodation establishments[304] located in a place or country of their visit. Benefit component would reflect the average daily expenditure of such a same-day visitor;
- Non-resident tourists, i.e. visitors from abroad who stay for at least one night in collective or private accommodation establishments located in a place or country of their visit. Benefit component would reflect the average day expenditure of such a tourist.

Thorough selection of socio-economic impact components is presented below (Table 87).

Table 42. Arguments for selecting benefit (damage) component

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Average expenditure per trip of a local same-day visitor	Direct impact	Willingness to pay for a tourist attraction is characterized as the main benefit component of tourism sector's projects in the guidelines of EC 2008. WTP can be evaluated by the method of travel costs or other valuation methods. The method of travel costs as the evaluation method of WTP reflects how much visitors have to spend to be able to visit a tourist attraction. Individual projects may be very different, therefore, to identify applicable values of social and socio-economic impact estimates, a more common approach is needed. Thus, it is advisable to use data from the Lithuanian Department of Statistics collected about expenditure

302 Which is reflected on categories used by the Lithuanian Department of Statistics.

303 Visitor – a person who goes from his residence to another location in Lithuania where he/she does not have a permanent residence for a period not exceeding 12 months and the main purpose of the trip is not a paid hired activity. Source: statistical research methodology of domestic tourism by the Lithuanian Department of Statistics.

304 Statistical research methodology of inbound tourism by the Lithuanian Department of Statistics.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		of same-day visitors and tourists. This decision corresponds to practical experience of CBA, because money that resident and non-resident tourists/visitors spend is considered by Lithuanian tourism projects' CBA to be the main benefit[305]. Moreover, income from domestic and inbound tourism in the national progress program of 2014-2020 is foreseen as a criterion for evaluation of investment to tourism infrastructure. The distinguished benefit component "Average daily expenditure of a local same-day visitor" reflects expenditure of one group of visitors and can be treated as WTP for a visit.
2. Average daily expenditure of a local tourist	Direct impact	Arguments are analogous to the case of previous benefit component. In this case, benefit component reflects travel costs of a local tourist that can be considered as WTP for a tourist attraction.
3. Average expenditure per trip of a non-resident same-day visitor	Direct impact	Arguments are analogous to the case of previous benefit component. In this case, benefit component reflects travel costs of a non-resident same-day visitor that can be considered as WTP for a tourist attraction.
4. Average daily expenditure of a non-resident tourist	Direct impact	Arguments are analogous to the case of previous benefit component. In this case, benefit component reflects travel costs of a non-resident tourist that can be considered as WTP for a tourist attraction.

Source: compiled by BGI Consulting and CSIL Milano.

All benefit components submitted in Table 42 are applicable to both distinguished types of common projects of tourism sector.

In both Lithuanian and foreign empirical practice, tests evaluating additional indirect impact can be found. However, such tests usually mean double-counting of benefits. Some examples of practice that need revision are presented below. Although, they are provided by foreign experts[306] and are based on foreign practice, practice that needs revision is also widely spread in Lithuania.

[305] For example: using Tytuvenai Bernardinai Monastery Ensemble for tourism purposes; Multifunctional sports and entertainment complex, Dubysos str. 10, Klaipeda.

[306] Source: http://www.ppcd.gov.mt/file.aspx?f=1703.

Insert 28. Examples of practice for revision, based on investments to a heritage object

1) Willingness to pay for a heritage object (good practice model) was estimated first in the cost and benefit analysis. However, increase in value of a land in neighborhood of the object and real property was considered as indirect benefit. Inclusion of such indirect benefit is overestimation of benefits, since increase in the land's value and real property already reflects value of WTP.

2) The same project's cost-benefit analysis in addition to WTP component estimated the other indirect benefit – increase in a non-resident's costs in local stores (in the neighborhood of the object). When WTP is assessed by the method of travel costs, such visitors' costs are part of travel costs and already reflect value of WTP. Using other methods to evaluate WTP and basing the analysis on the approach of general balance, these additional costs mean that they will decrease in other areas of the country. Therefore, such indirect benefit should not to be assessed.

3) Another indirect benefit of the same project – benefit of directly created additional jobs due to the implementation of the project. However, these additional jobs are not benefit but the project's costs which should be converted into economic value by appropriate shadow wage.

Source: compiled by BGI Consulting and CSIL Milano.

1.12.3. Calculation Methodology and Application Instructions

1. The average expenditure per trip of a local same-day visitor

Calculation methodology and calculated estimate value

As stated in the guidelines of EC 2008, to assess visitors' WTP for touristic attractions, the travel costs method can be used to reflect how much visitors spend to visit an object. A common CBA is an applicable provision for tourism sector in order to divide users of project results into some or more groups that unite these users by certain features. Local same-day visitors are usually distinguished as a separate group.

Costs incurred of local same-day visitors visiting a particular object can be different; however, it is assumed that average costs of a local same-day visitor could be close to average expenditure per trip of a local same-day visitor, calculated on the basis of information published by the Lithuanian Department of Statistics.

A table published by the Lithuanian Department of Statistics "M4091501: Number and expenditure of local same-day visitors. Features: administrative territory" covers two indicators: expenditure of same-day visitors, millions of litas, and number of trips of same-day visitors, thousands. The first indicator is divided by the second, yielding the average expenditure per trip of a local same-day visitor:

[Average expenditure per trip of a local same-day visitor] = 1,000 * [expenditure of same-day visitors, mln. LTL] / [number of trips of same-day visitors, thousands]

It is proposed to refer to values of the Republic of Lithuania since implemented projects can be very different even in the same region. In 2011, the average expenditure per trip of a local same-day visitor is equal to 74.88 LTL. Applicable value for 2013 was calculated on the basis of increase in average consumer prices (according to the statistics published by the International Monetary Fund[307]). The applicable estimate value of benefit component for 2013 **is equal to 79.13 LTL:**

74.88 LTL *1.045 = 78.25 LTL.

As living standards are growing, expenditure of local visitors is expected to increase, thus, estimate value of benefit component should be recalculated in the subsequent year taking into account the growth of the real GDP per capita, according to the International Monetary Fund's forecasts[308]. Although IMF's forecast does not cover the entire period of the economic analysis, considering the resulting uncertainties, it can be said that the annual growth rate for the remaining period is equal to the average of the last five year's forecast.

Comparison with other countries. Analyzing foreign experience, similar estimates of benefit components were not identified on a national scale. WTP for natural and cultural heritage is estimated individually for each project, usually using contingent valuation method, i.e. expressed preferences method[309]. Meanwhile, to determine valid estimates of benefit component on a national scale, it is necessary to choose a more general case defining estimates, such as data on the average daily expenditure of a visitor published by statistical services. The same applies to the remaining benefit components, reflecting other categories of visitors.

Application instructions

To estimate the annual perceptible local same-day visitors' benefit of an object, estimate value of benefit for specific year is calculated and multiplied by the planned number of such visitors and then – by the average value of an object in general value of visitors' tourist route. The following aspects must be taken into consideration when using the estimate of benefit component:

- The planned number of local same-day visitors must be realistic. The information about the number of visitors going to Lithuanian museums is submitted in Sector **Error! Reference source not found.** which can be used as a guide planning the general number of visitors for analysing an object. For example, thirty thousand and more visitors (including same-day tourists, local and foreign) a year can only be attracted by some exclusive objects;
- The analysis on visitors' attraction and their flow should distinguish how many visitors would arrive exclusively for an object and how many would visit that object only as one of their travel points. Also, if possible, it is desirable to distinguish what role that analyzed object plays to decide on a trip;
- In order to avoid overestimation of benefit and damage calculation, it is necessary to consider whether financial income from the visitor of the object is planned in the financial analysis. Such financial revenue should be eliminated because visitors' expenses on food, drinks, souvenirs and so on are already reflected in travel costs.

[307] Source: http://www.imf.org/external/ns/cs.aspx?id=28 (indicator: Inflation, average consumer prices).
[308] Source: http://www.imf.org/external/ns/cs.aspx?id=28 (National currency).
[309]For example, see Table 4.1 at the adress below in accesible studio: http://www.english-heritage.org.uk/publications/valuation-historic-environment/valuation-historic-environment-final-rep.pdf.

Insert 29. Example of calculating an object's perceived benefit estimate of local same-day visitors

For example, the analysis on an object's attraction showed that adjusting a cultural heritage object to sustainable tourism's needs might attract additionally 5,000 visitors a year of which 4,500 would be local same-day visitors. However, the analysis on the expected visitors' flow shows that additional local same-day visitors would visit the object while travelling according to their tourist route i.e. the object does not have any impact on deciding a trip; however, if the project wasn't implemented, these visitors wouldn't visit the object at all. Let's say that the expert carrying out the analysis on visitors' flow identified (providing their expert opinion) that the object covers 20 % of the value of the mentioned tourist route. Therefore, the perceived benefit of the object of local same-day visitors is calculated as follows:

4,500 visitors * [estimate in given year] * 0.2

For example, in 2013, that benefit would be:

4,500 visitors * 78.25 LTL * 0.2 = 70,425.00 LTL

Let's say, on average 5 LTL is planned to be received from a local same-day visitor (for example, from selling souvenirs). Financial income which makes 22,500 LTL from 4,500 local same-day visitors is eliminated in order to avoid calculation of benefit overestimation.

Source: compiled by BGI Consulting and CSIL Milano.

Estimate update instructions

It is advisable to update estimates of benefit component every year. Applicable value of estimate for the first year of CMB analysis is calculated using the algorithm above. Applicable values for the remaining year of CMB analysis is calculated in consideration with the growth of the real GDP per capita (based on the International Monetary Fund's forecasts as described previously).

2. The average daily expenditure of a local tourist

Calculation methodology and calculated estimate value

Local tourists – one more category of visitors of tourist attractions. The table published by the Lithuanian Department of Statistics „M4091503: Local tourists' trips with one or more overnight stays. Features: administrative territory, place of departure, arrival" covers such indicators: number of overnight stays of local tourists, thousands, and expenditure of local tourists, millions litas. The second indicator is divided by the first, yielding the average daily expenditure of a local tourist:

[Average daily expenditure of a local tourist] = 1,000 * [expenditure of local tourists, millions LTL] / [number of overnight stays of local tourists, thousands]

It is proposed to refer to values of the Republic of Lithuania since implemented projects can be very different even in the same region. In 2011, the average daily expenditure per trip of a local tourist is equal to 57.89 LTL. Applicable value of 2013 was calculated on the basis of increase in average consumer prices (according to the statistics published by the International Monetary Fund[310]) and **is equal to 60.50 LTL** (recalculation algorithm is similar to the case of previous benefit component estimate).

Like the previous category of visitors, the value of benefit component should be recalculated in subsequent year considering the growth of the real GDP per capita (according to the IMF's forecast).

Comparison with other countries. See benefit component „The average expenditure per trip of local same-day visitors".

Application instructions

To estimate the annual perceptible local tourists' benefit of an object, the estimate value of benefit for specific year is calculated and multiplied by the planned number of such visitors and then – by the average value of an object in general value of visitors' tourist route. The same aspects as in other visitors' category must be taken into consideration when using the estimate of benefit component.

Insert 30. Example of calculating an object's perceived benefit estimate of local visitors

For example, the analysis on an object's attraction showed that adjusting a cultural heritage object to sustainable tourism's needs might attract additionally 5,000 visitors a year of which 100 would be local tourists. However, the analysis on the expected visitors' flow shows that additional local visitors would visit the object while travelling according to their tourist route i.e. the object does not have any impact on deciding a trip; however, if the project wasn't implemented, these visitors wouldn't visit the object at all. Let's say that the expert carrying out the analysis on visitors' flow identified (providing their expert opinion) that the object covers 20 % of the value of the mentioned tourist route. Therefore, the perceived benefit of the object of local visitors is calculated as follows:

100 tourists * [estimate in given year] * 0.2

For example, in 2013, such benefit would be:

100 tourists * 60.50 LTL* 0.2 = 1,210.00 LTL

Sources: compiled by BGI Consulting and CSIL Milano.

Estimate update instructions

Updating the estimate of benefit component should be carried out in the same way as the previous case of benefit component.

3. The average expenditure per trip of a foreign same-day visitor

Calculation methodology and calculated estimate value

[310] Source: http://www.imf.org/external/ns/cs.aspx?id=28 (indicator: Inflation, average consumer prices).

Foreign same-day visitors – one more category of tourists. The table published by the Lithuanian Department of Statistics „M4091301: The main indicators of inbound tourism. Features: year" covers the indicator: the average expenditure per trip of same-day visitors, LTL.

In 2012, the average expenditure per trip of a foreign same-day visitor is equal to 303.80 LTL. Applicable value of 2013 was calculated considering increase in average consumer prices (based on the statistics[311] published by the International Monetary Fund) and **is equal to 307.75 LTL** (recalculation algorithm is similar to the previous case of benefit component).

Like in the previous cases of visitor categories, the value of benefit component in subsequent year should be recalculated considering the growth of the real GDP per capita (according to the IMF's forecast).

Comparison with other countries. See benefit component „The average expenditure per trip of a local same-day visitor".

Application instructions

To estimate the annual perceptible foreign same-day visitors' benefit of an object, the estimate value of benefit for specific year is calculated and multiplied by the planned number of such visitors and then – by the average value of an object in general value of visitors' tourist route. The same aspects as in other visitors' category must be taken into consideration when using the estimate of benefit component.

Insert 31. Example of calculating an object's perceived benefit estimate of foreign same-day visitors

For example, the analysis on an object's attraction showed that adjusting a cultural heritage object to sustainable tourism's needs might attract additionally 5,000 visitors a year of which 200 would be foreign same-day visitors. However, the analysis on the expected visitors' flow shows that additional foreign same-day visitors would visit the object while travelling according to their tourist route i.e. the object does not have any impact on deciding a trip; however, if the project wasn't implemented, these visitors wouldn't visit the object at all. Let's say that the expert carrying out the analysis on visitors' flow identified (providing their expert opinion) that the object covers 10 % of the value of the mentioned tourist route. Therefore, the perceived benefit of the object of foreign same-day visitors is calculated as follows:

200 visitors * [estimate in given year] * 0.1.

For example, in 2013, such benefit would be:

200 visitors * 307.75 LTL* 0.1 = 6,155.00 LTL.

Source: compiled by BGI Consulting and CSIL Milano.

Instructions for updating the estimate

Updating of benefit component estimate should be carried out in the same way as the previous case of benefit component.

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[311] Source: http://www.imf.org/external/ns/cs.aspx?id=28 (indicator: Inflation, average consumer prices).

4. Average daily expenditure of a foreign tourist

Methodology of calculation and calculated value of estimate

Foreign tourists – one more category of tourists. The table published by the Lithuanian Department of Statistics „M4091301: The main indicators of inbound tourism. Features: year" covers the indicator: the average daily expenditure of tourists, LTL.

In 2012, the average daily expenditure of a foreign tourist is equal to 289.40 LTL. Applicable value of 2013 was calculated considering increase in average consumer prices (based on the statistics[312] published by the International Monetary Fund) and **is equal to 293.16 LTL** (recalculation algorithm is similar to the previous case of benefit component).

Like the previous cases of visitor categories, the value of benefit component in subsequent year should be recalculated considering the growth of the real GDP per capita (according to the IMF's forecast).

Comparison with other countries. See benefit component "The average expenditure per trip of a local same-day visitor".

Instructions for application

To estimate the annual perceptible foreign tourists' benefit of an object, the estimate value of benefit for specific year is calculated and multiplied by the planned number of such visitors and then – by the average value of an object in general value of visitors' tourist route. The same aspects as in other visitors' category must be taken into consideration when using the estimate of benefit component.

Insert 32. Example of calculating an object's perceived benefit estimate of foreign visitors

For example, the analysis on an object's attraction showed that adjusting a cultural heritage object to sustainable tourism's needs might attract additionally 5,000 visitors a year of which 200 would be foreign visitors. However, the analysis on the expected visitors' flow shows that additional foreign visitors would visit the object while travelling according to their tourist route i.e. the object does not have any impact on deciding a trip; however, if the project wasn't implemented, these visitors wouldn't visit the object at all. Let's say that the expert carrying out the analysis on visitors' flow identified (providing their expert opinion) that the object covers 20 % of the value of the mentioned tourist route. Therefore, the perceived benefit of the object of foreign visitors is calculated as follows:

200 tourists * [estimate in given year] * 0.2.

For example, in 2013, the benefit would be:

200 tourists * 293.16 LTL* 0.2 = 11,726.40.

Source: compiled by BGI Consulting and CSIL Milano.

[312] Source: http://www.imf.org/external/ns/cs.aspx?id=28 (indicator: Inflation, average consumer prices).

Estimate update instructions

Updating the estimate of benefit component should be carried out in the same way as the previous case of benefit component.

1.12.4. Evaluation table of social - economic factor impact on tourism industry

In summary, the estimate of socio-economic factor is presented in a table (Table 88), that was presented in Technical task. According to requirements of Technical task and in order to prevent damage and benefit overestimation (double counting), table of indicators has to be related to conversion factor that was set by service provider. However, none of set estimates is related to set conversion factors of costs and this is why there is no opportunity for the risk of damage and benefit overestimation (it is important to pay attention to other provisions about benefit overestimation that were presented in section "Suggested impact (benefits and costs) components, estimates and the arguments of choice".

Table 88. Evaluation of socio-economic factor influence in tourism industry

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload (table of strong, reliable and significant ratings (at least three)	Quantitative expression, LTL
Tourism	N/a	N/a	1.Medium one travel expenses of local day-to-day visitor (direct impact)	78.25 LTL in 2013
Tourism	N/a	N/a	2. Medium day expenses of local tourist (direct impact)	60.50 LTL in 2013
Tourism	N/a	N/a	3. Medium one travel expenses of foreign day-to-day visitor (direct impact)	307.75 LTL in 2013
Tourism	N/a	N/a	4.Medium day expenses of foreign tourist (direct impact)	293.16 LTL in 2013

Notes:

* In order to prevent damage and benefit overestimation (double counting), Table of indicators has to be related to conversion factor that was set by service provider.

1.12.5. Annexes (Tourism industry)

Annex 1.The number of visitors in Lithuanian museums

Table 1. The number of visitors in Lithuanian museums in 2012

Name	General number of visitors	Individual visitors	Organized visitors	Number of visitors in educational activities.
National museums				
National Museum of Lithuania	259454	208192	34113	17149
Lithuanian Art Museum	267210	208124	32013	27073
M.K. Čiurlionis National Museum of Art	121111	79267	34148	7696
National Museum- Palace of the Grand Dukes of Lithuania	75359	51855	13109	10395
Total in National museums:	**723134**	**547438**	**113383**	**62313**
Republican museums				
Vilna Gaon Jewish State Museum	16107	8695	6249	1163
Vytautas the Great War Museum	41083	29702	8837	2544
Museum of the Ninth Fort of Kaunas	34563	17440	15367	1756
Maironis Lithuanian Literature Museum	62527	37808	13746	10973
Lithuanian Aviation Museum	15406	2488	9679	3239
Open-Air Museum of Lithuania	80084	55580	9178	15326
Šiauliai " Museum Auša"	120113	78805	26092	15216
Trakai History Museum	337051	237999	97046	2006
Kernavė Archaeological Site Museum	12403	4193	5656	2554
Lithuanian Theatre, Music and Film Museum	12503	5668	2272	4563
Lithuanian Ethno-Cosmology Museum	29196	6001	22975	220
Kaunas Tadas Ivanauskas Museum of Zoology	40203	9044	30000	1159
Vaclovas Intas National Stone Museum	9067	5279	2264	1524
Lithuanian Sea Museum	129202	103350	19076	6776
Bishop Museum of Samogitians	5810	1754	3056	1000
Lithuanian Geology Museum	2893	31	2167	695
Museum of Lithuanian Education History	5012	1069	1800	2143
Total in Republic museums:	**953223**	**604906**	**275460**	**72857**
Local government museums (memorial, local lore and etc.)				
A. Baranauskas Granary and A. Vienuolis-Žukauskas Museum	77039	24485	33106	19448
The B.Grincevičiūtės Memorial Flat-Museum "Beatričės namai"	1636	1025	337	274

Name	General number of visitors	Individual visitors	Organized visitors	Number of visitors in educational activities.
Lithuanian President K.Grinius Memorial Museum	2374	1579	475	320
Professor Adomas Hrebnickis Memorial Museum	2020	210	1780	30
Martynas JankusMuseum of Pagėgiai Municipality	1945	468	1192	285
Antanas and Jonas Juškai Ethnic Culture Museum	3382	256	2837	289
Vincas Krėvė-Mickevičius Memorial Flat-Museum	3280	495	2095	690
Vincas Krėvė-Mickevičius Memorial Museum of Varėna Municipality	856	196	480	180
Thomas Mann Memorial Museum	36368	8057	27881	430
Juozas Naujalis Memorial Museum	2177	1269	649	259
V.Mykolaitis-Putinas Memorial Flat-Museum	1879	108	1500	271
M.and K.Petrauskai Lithuanian Music Museum	6008	2676	2407	925
Literary Museum of A Pushkin	5523	2275	2898	350
Povilas Stulga Museum of Lithuanian Folk Instruments	3061	464	263	2334
Šiauliai Region Literature Museum	1530	73	1279	178
Marija and Jurgis Šlapeliai House-Museum	9627	4605	4620	402
Museum of Bishop Motiejus Valančius	1005	299	521	185
Vydūnas Museum of Kintai Vydūnas Cultural Centre	1959	679	1117	163
House Museum of Venclovai family	2736	1870	756	110
Akmenė Region Museum	3513	880	2119	514
Alytus Ethnographic Museum	13288	5955	4380	2953
Birštonas Museum and its' branch (Sacral Museum)	8115	3759	3161	1195
Biržai Region Museum "Sėla"	34494	12890	10239	11365
Daugyvene Museum- Reservation on History of Culture	58899	46350	12497	52
Druskininkai City Museum	705	283	30	392
Literature and Art Museum of Elektrėnai Municipality	4750	150	4200	400
Gargždai Area Museum	5360	1622	2842	896
Jonava Area Museum	13194	1978	6756	4460
Joniškis Museum of History and Culture	1617	602	401	614
Jurbarkas Area Museum	8241	1721	4922	1598
Kaunas City Museum	23100	16834	2077	4189
Kaišiadoris Museum	2053	803	1008	242
Kelmė Area Museum	9740	1420	5474	2846
Kėdainiai Area Museum	18973	2333	12654	3986
Kretinga Museum	75278	35505	37918	1855
Kupiškis Ethnographic Museum	8661	2509	4208	1944
Lazdijai Area Museum	12642	6247	3967	2428
Marijampolė Area Museum	9380	3656	4965	759
Mažeikiai Museum	15836	3728	9304	2804
History Museum of Lithuania Minor	21265	8152	3700	9413
Merkinė Local Lore and Genocide Museum of Varėna	0	0	0	0
Molėtai Area Museum	15050	5735	6705	2610

Name	General number of visitors	Individual visitors	Organized visitors	Number of visitors in educational activities.
Neringa Museum of History	15136	8730	5980	426
Panevežys Local Lore Museum	18159	3580	8610	5969
Pasvalys Area Museum	28466	20783	4125	3558
Art Museum of Samogitians	31443	18026	12898	519
Prienai Area Museum	13779	932	9614	3233
Raseiniai Local Lore History Museum	24600	9000	14000	1600
Oginski Cultural History Museum of Rietavas	3838	325	3377	136
Rokiškis Area Museum	31387	8507	8632	14248
Skuodas Museum	2012	322	812	878
Šilalė Vladas Statkevičius Museum	9323	2962	5797	564
Šilutė Museum	6250	3032	2455	763
Nalšia Museum	4194	2954	683	557
Tauragė Area Museum	4519	199	3820	500
Ukmergė Local Lore Museum	8856	4801	3251	804
Utena Local Lore Museum	13641	5963	5566	2112
Vilkaviškis Area Museum	7029	731	3992	2306
Zanavykai Area Museum	2134	892	1027	215
Zarasai Area Museum	2036	864	487	685
Smogitians Museum "Alka" of Telšiai Municipality	12446	4894	6393	1159
Anykščiai Art Museum (Angel's Museum)	7739	3541	3454	744
Kražiai M. K. Sarbievijus Cultural Centre Museum	926	298	543	85
Total in local government museums :	**776472**	**315537**	**335236**	**125699**
Departmental museum				
Money Museum of the Bank of Lithuania	24466	14107	10077	282
The Museum of Genocide Victims	54616	33506	18789	2321
The Roads Museum "Automagistralė"	3349	645	2640	64
The Museum of Lithuanian Military Academy of General Jonas Žemaitis				
Customs Museum	2220	97	1085	1038
Vilnius Academy of Art Museum	23845	23400	300	145
LSMU Museum of History of Lithuanian Medicine and Pharmacy	7669	1359	6310	0
Museum of Medicine history in Vilnius University	395	42	353	0
Lithuanian Grand Duke Gediminas 1st Infantry Regiment and Lithuanian Grand Duke Gediminas Staff Battalion Museum	45	0	45	0
Šiauliai University Museum	500	50	350	100
Lithuanian Railway Museum	14729	5782	8407	540
Border Guard Museum	266	22	181	63

Name	General number of visitors	Individual visitors	Organized visitors	Number of visitors in educational activities.
Lithuanian sport Museum	5208	510	2248	2450
Museum of the Lithuanian Radio and Television	4345	0	1679	2666
Total in departmental museums:	**141653**	**79520**	**52464**	**9669**
Non-state museums and public institutions				
Grūtas Park	61895	42995	18900	0
Park of Europe	34200	21416	10054	2730
Antanas Mončys House-Museum	6158	4776	1032	350
Lithuanian Energy Museum	19669	5762	11719	2188
Total in non-state museums and public institutions	**121922**	**74949**	**41705**	**5268**
Total of Lithuanian museums:	**2716404**	**1622350**	**818248**	**275806**

Source: the table was made by BGI Consulting and CSIL Milano according to Association of Lithuanian museums data.

1.13. Public infrastructure for business

1.13.1. A Set of Conversion Factors Applicable to Costs

A set of conversion factors applicable to project costs, as well as a theoretical basis, calculation methodology, application instructions and value updating requirements are presented in part I of the report.

1.13.2. Proposed Benefit (Damage) Components, Estimates and Arguments for Selection

The selection of socio-economic impact (benefit and harm) components was based on the list of the types of approved joint projects in the sector of public infrastructure for business (Table 89).

Table 43. The Distinguished Types of Joint Projects in the Sector of Public Infrastructure for Business

Project type	Project examples
1. Investment in the development of the infrastructure necessary for business in connection with RDI, and updating of the existing infrastructure	1.1. Scientific research and experimental development (RDI) and innovation infrastructure 1.2. Centres of excellence, especially European-wide centres, infrastructure 1.3. Development and installation of equipment and technology designed to engage in international research infrastructures
2. Investment in the infrastructure necessary for business in connection with the development of activities	2.1. Development of industrial parks and FEZ infrastructure according tosmart specialization

Source: developed by BGI Consulting and CSIL Milano on the basis of the information provided by SFMIS andthe Ministry of Economy, and specified in strategic planning documents.

As stated in the EC Guidelines of 2008, the main benefits of public infrastructure for business (such as industrial zones and technology parks) gained by companies using this infrastructure is shown by the improvement of such companies’ positions in the market, for such reasons as reduced transport costs, reduced rates of basic services, technology improvements and the like. Such benefits are most clearly manifested through the development of additional added value.[313]

The benefit of Industrial parks infrastructure is also often associated with the attracted direct foreign investment. For example, "The accumulated amount of direct foreign investment per person" is established as an assessment criterion in the National Progress program (The task of the Program " 3.1.2. Promoting entrepreneurship and business development, including foreign direct investments," one of the implementation directions of which is" to develop industrial parks, free economic zones and public logistics centres infrastructure"). However, direct foreign investment should be seen as a means to achieve the end result, i.e., the real benefit is an additional added valuecreated due to foreign direct investment. This is confirmed by the revised feasibility studies carried out in Lithuania providing the assessment of an additional added value or its individual elements, such aswages paid to employees hired to implement the project.

In case of open access to RDI infrastructure for business, benefits are often associated with registered patents, growing business expenditure on RDI and the strengthening the cooperation between business and the University. All these results should be treated as interim results, while the actual and final benefit is the created additional added value.

For example, a company has taken a decision to create a new product for the purpose of developing the company, through the RDI activities. As the most suitable option the company chooses to carry out RDI activities through open access to RDI infrastructure and resources offered by the University. In carrying out RDI activities, the company incurs the costs related to RDI and, for the purpose of the designed product protection it registers the patent. The launched manufacture of the new product will allow the company to create extra added value, which will be considered a final and actual outcome. The income from the company using the open access to RDI infrastructure will be received by the manager of such an infrastructure (who will create added value) as well, however, such income will be reflected in the financial analysis of the open access to the RDI infrastructure project, while the socio-economic impact, as mentioned, should berelated to the additional added value, which will be created through the completion of RDI activities using the created RDI infrastructure. Such benefits are directly confirmed by the revised feasibility studies carried out in Lithuania.

As shown by the empirical case studies,[314]one of the best ways to assess the benefits of public infrastructure for business is to express it through added value that is created by one employee. The suitability of this indicator can also be based on the fact that the results of such investment should be (and often are) measured by the number of jobs created. The international economic literature also

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[313]For example, this benefit component is distinguished in a number of feasibility studies conducted in Lithuania, such as a feasibility study on Industrial-commercial zones development in Vilnius district, installation of engineering networks and communications, Klaipėda Science and Technology Park infrastructure development in the Marine Valley, and development of Photovoltaic Technology Cluster of Open Access to the RDI Infrastructure (PVPLIUS).

[314] For example, a feasibility study on Photovoltaic Technology Cluster of Open Access to the RDI Infrastructure, and an investment project under the project "ICT and BIO Technology Parks and Companies' "Greenfield Investment" Territory Engineering Networks and Communications Equipment and ICT Business Incubator and Technology Centre Construction and Installation".

distinguishes direct job creation and income generation as the main ways in which business benefits from investment in public infrastructure.[315]

The investments being considered are generally aimed at encouraging of the production of high value-addedand the provision of high value-services. Therefore, as shown by empirical case studies, the socio-economic impact estimates should be linked to the added value that is created in economic activities related to high and medium-high technology (HMHT) or knowledge-intensive sectors. Sub-division would not be appropriate, since usually it is not known what specific economic activity is performed by the company that will use the created public infrastructure for business.

As stated in the EC Guidelines of 2008, investment in industrial zones and technology parks can not only bring benefits but also pose a negative socio-economic impact (damage). Such damage is primarily related to the environmental costs resulting from manufacturing process (land, water and air pollution, visual pollution, noise, waste). The environmental impact, such as visual pollution is distinguished more from a theoretical standpoint, while in practice only the impact of gas (CO2) emissions causing global warmingis distinguished and assessed (for example, see the EC Guidelines of 2008). It would be useful to distinguish theestimate of gas emissionas well, because the effect of gas does not depend onthe emission area, while otherimpact of pollution resulting from manufacturing process is more localized and less spreads in the environment.

Also, as indicated in the EC Guidelines of 2008, investment in industrial zones and technology parks usually leads to additional costs due to increased traffic congestion, for example, the already intense traffic became even heavier when a public infrastructure for business was created and developed in Saulėtekis (Vilnius).

The table below (Table 90) shows the arguments for a detailed socio-economic impact (benefit and harm) component selection. The attribution of benefits (compensation) components to specific types of projects is provided Annex 1 to the Sector.

Table 44. The Arguments for Benefit (damage) Component Selection

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
1. Added value created per employee.	Direct impact	As indicated in EC Guidelines of 2008, the main benefit gained by companies from public infrastructure for business (such as industrial zones and technology parks) is the improvement of companies',using the infrastructure, positions in the market. As shown by empirical case studies, the most appropriate way to express such an improvement of companies'positions in the market is to show its final (actual) result - theadded value. Added value created by one employee should be considered the most appropriate form of benefit component's expression. Since the investments in question are generally aimed at encouraging the production of high value-added production and the

[315] For example, The Multi-Donor Investment Climate Advisory Service of the World Bank Group. Special Economic Zones: Performance, Lessons Learned, and Implications for Zone Development. – April 2008.

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		provision of high value-added services, the socio-economic impact estimates should be related to the added value created in high-value economic activities, such as economic activities of high and medium-high technology (HMHT) and knowledge-intensive sectors(such a choice is based on empirical case studies).
2.The added valuegrowthper employee	Direct impact	Often, a project may not be aimed at creating new jobs but at developing new products, carrying out the production or process innovation or entering new markets without the objective of creating new jobs. I.e., The net benefit to society is not a new job created, as a result of project implementation, but the increase in the added value created by the same person.In order to establish a unified estimate for the added value growth, it would seem most appropriateto apply the difference between the added value created in high value-added economic activities and the added value created in the remaining economic activities.
5. Carbon dioxide (as a greenhouse gas) emissions increase	Indirect impact	The impact has a dual source. First, as indicated in the EC Guidelines of 2008, the increase in greenhouse gas emissions is caused by production activities launched due to investment. Secondly, the increase in the gas emissions is caused by intensified traffic congestion resulting from the creation of the infrastructure (the arguments are equivalent to those provided below to justify componentsof the socio-economic impact). It is useful to distinguish the estimate of gas emission, since the impact of gas does not depend on the emission area.
3.Time losses due to increased traffic congestion	Indirect impact	As stated in the EC Guidelines of 2008, investment in industrial zones and technology parks usually leads to additional costs due to increased traffic congestion (in fact, a global effect - which should be analysed - can be both positive and negative). The impact of traffic congestion increase is normally measured by anincrease in the gas emissions causing air pollution and greenhouse effect, as well as the resulting time losses. In this case, the estimate reflects time losses. I.e., individuals, who used to travel through the project area in question,will experiencetime losses due to the project implementation (during the construction phase due to traffic restrictions, as well as during the operation due to the increased flow of passengers). Although thefeasibility studies in question that were carried out in Lithuania do not identify this impact, however, it is considered probable. For example, the already intense traffic became even heavier when a public infrastructure for business was created and developed in Saulėtekis (Vilnius). Due to the specific nature of the

Component	Type	Arguments for choosing (theory, precedence, conformity to strategic aims and expected development of the sector)
		sector, such losses should be experienced by mainly persons traveling to work.
4. Air pollution increase due to increased traffic congestion	Indirect impact	The arguments are equivalent to those provided to justify the previously discussed component of socio-economic impact. In this case, the estimate is intended to reflect the costs caused by air pollution resulting from the increased traffic congestion.

Source: developed by BGI Consulting and CSIL Milano.

The feasibility studies conducted in Lithuania also provide attempts to calculate the benefit of the project resulting from indirect jobs created, for example, workers', employed in industrial area, additional consumption. However, in accordance with the approach proposed in the EC Guidelines of 2008, the evaluation should include only the direct creation of jobs and external environmental impact, while the impact on regional growth should not be assessed. This is based on the fact that usually, such indirect jobs are created by transferring operations from other areas (i.e., other areas experience benefit (damage)), so the net benefit to society is usually negligible. Therefore, the objective to assess the benefit gained from indirectly created jobs would pose a risk of double-counting of benefits.

Likewise, there are common cases in practice where the attempts to include savings intended for unemployment insurance benefits and other social benefits into the project benefits would also pose a risk of double counting of benefits. The reason is that such benefits are attributable to transfer payments, which, in accordance with the EC Guidelines of 2008, are not included in the economic analysis. I.e., such social benefits meancosts incurred by one group of societyand benefits gained by another group of society. Meanwhile, the economic analysis should include only pure public benefits, such as an increase in added value[316].

1.13.3. Calculation Methodology and Application Instructions

1. Added value created per employee

Calculation methodology and calculated estimate value

As indicated in EC Guidelines of 2008, the main benefit gained by companies from public infrastructure for business (such as industrial zones and technology parks) is the improvement of companies', using the

[316]For example, see "The Department for Work and Pensions Social Cost-Benefit Analysis framework. Methodologies for estimating and incorporating the wider social and economic impacts of work in Cost-Benefit Analysis of employment programmes". – 2010.

infrastructure, positions in the market. As shown by empirical case studies, the most appropriate way to express such an improvement of the companies' positions due to using the public infrastructure for business is to show its final (actual) result - the added value.

The investments that are being considered are generally aimed at encouraging of the production of high value-added and the provision of high value-services. Therefore, the socio-economic impact estimates should be linked to the added value that is created in high-value added economic activities, such as economic activities related to high and medium-high technology (HMHT) or knowledge-intensive sectors.

Table "M2010301: The Country's Economic Performance. Features: Type of Economic Activity (CEA 2)"published by the Lithuanian Department of Statistics includes data on the value-added per one employee according to the economic activity performed (CEA 2). The calculations of the estimate were based on data of the year 2011, as the latest data currently available reflects the situation in the year 2011. The estimatesapplicable to the year 2013 was calculated on the basis of the nominal GDP growth per 1 inhabitant (based on the data provided by the International Monetary Fund[317]).The calculations and estimates are presented in Table 91 The calculations exclude the knowledge-intensive[318]sectors that are not related to the investment that is being analysed.

Table 45. The Added Value Created per Employee

Types of economic activities	AV per employee in 2011., LTL	AV per employee in 2012., LTL	AV per employee in 2013., LTL
C20 Manufacture of chemicals and chemical products	409,500		
C21 Manufacture of basic pharmaceutical products and pharmaceutical preparations	303,400		
C26 Manufacture of computer, electronic and optical products	124,800		
C27 Manufacture of electrical equipment	57,000		
C28 Manufacture of machinery and equipment n.e.c.	108,700		
C29_C30 Manufacture of transport equipment	112,800		
J Information and communication	108,100		
K Financial and insurance activities	121,700		
M Professional, scientific and technical activities	65,700		
AVERAGE	**156,856**	**168,155**	**178,781**

Source: developed by BGI Consulting and CSIL Milano.

Since the created real added value should increase over subsequent years, the estimates of the CBA period,applicable to future years,must be recalculated according to the real GDP per capita growth. Long-

[317] Source: http://www.imf.org/external/ns/cs.aspx?id=28.

[318] N Administrative and support service activities; O_TO_Q Public management and defence; compulsory social insurance; education; human healthcare and social work; R Artis, entertainment and recreational activities.

term real GDP per capita growth forecasts for Lithuania, as well as for other countries, are prepared by the International Monetary Fund[319]. While it is true that the IMF forecast does not cover the entire economic analysis period, therefore, taking into account the resulting uncertainties, it is appropriate to state that the annual growth rate for the remainder of the period is equal to the average growth rate over the last year[320]

When the authors of a feasibility study have more accurate data on thecompanies'in question economic activity or the size of the added value created, it is appropriate to apply a specific value of the estimate. For example, if the infrastructure is focused only on the attraction of chemicals and chemical products manufacturers, it is appropriate to use the added value per employee created in the economic activity "C20Manufacture of chemicals and chemical products". The specific economic value applicable to current financial year should be calculated on the basis of the value of the latest year available, converting it into a current price according to the nominal GDP per capita growth (based on the data provided by IMF[321]). The estimates of the CBA period, applicable to future years, must be recalculated according to the real GDP per capita growth (in accordance with the instructions above).

Comparison with other countries. During the analysis of foreign experience, no national–scale estimates have been identified. Additional income received by companies is generally assessed individually under each project, in particular as regards e*x-post* cost-benefit analysis[322]. Meanwhile, in order to establish nationally valid estimates, it is necessary to select estimates reflecting a more general case, such as the data published by statistical services.

Application instructions

To calculate annual added value created by business enterprises due to a developed infrastructure, the value estimated for a particular year is multiplied by the number of jobs created as a result that companies used such an infrastructure (i.e., the number of jobs that would not have been created during the relevant year if the project had not been implemented). When applying a fixed estimate it is necessary to take into account the following aspects:

- The planned number of jobs that will be created by companies must be realistic (See Annex 2 to the Sector);
- The conducted analysis of potential users of the infrastructure should establish what part of the jobs will be created exclusively due to the objectanalysed, and what part of the jobs would be even in the absence of the project (in the absence of information a conservative assumption should be that 80 % of jobs would be created without the project);
- When applying a fixed estimate, benefits gained due to theindirectly created jobs should not be additionally assessed, as this would cause the risk of double-counting of the benefits.This is based

[319] For the period of 6 years, in national currency (http://www.imf.org/external/ns/cs.aspx?id=28).

[320] The annual growth rate for the remainder of the period has been calculated as the average of an annual GDP per capita growth rate over the five-year forecast period.

[321] Source: http://www.imf.org/external/ns/cs.aspx?id=28.

[322]For example, CSIL for European Commission, 2011, the port of Gioia Tauro, prepared for the EX POST EVALUATION OF INVESTMENT PROJECTS CO-FINANCED BY THE EUROPEAN REGIONAL DEVELOPMENT FUND (ERDF) AND COHESION FUND (CF) IN THE PERIOD 1994-1999.

on the standpoint expressed in the EC Guidelines of 2008 that usually the indirect jobs are created by transferring operations from other areas (i.e., other areas experience benefit (damage)).

The following is an exampleof the value-added per employee estimate application.

Insert 33. Example of the value-added per employee estimate application.

For example, a conducted feasibility study on an industrial area has shown that 30 jobs per hectare could be created. The size of the industrial area intended to be used is 40 hectares. The authors of the feasibility study also provide that in the third year of operation in the industrial area, 60 % of the area will be leased. The feasibility study does not reveal the number of jobs that would be created without the project (perhaps in other areas of Lithuania), therefore the person doing the CBA has decided to follow a conservative assumption that such jobs constitute for 80% of the total number of jobs to be created. In this way, in the third year of activity, the benefit received due to jobs created is equal to: (40 hectares * 60 %) * (30 jobs * 20 %) * The value of the estimate of the years in question.

Source: developed by BGI Consulting and CSIL Milano.

In cases where the researchers conducting the feasibility study have more accurate data on the economic activity performed by the companies in question or the size of the added value created, it is appropriate to apply a specific value of the estimate, but in this case strong arguments must be presented in support of this choice (for example, showing why it is expected that the infrastructure will be usedby namely the companies performing certain economic activities).

Estimate update instructions

It is offered to renew the value of the added value per employee estimate every year. The updated statistics on the value-added per employee (in accordance with CEA 2) is published by the Lithuanian Department of Statistics each year. The estimate applicable in the current year is calculated in accordance with the above indicated instructions for calculating the estimates. The estimates of the CBA period, applicable to future years, must be calculated by recalculating the value applicable for current year according to the real GDP per capita growth (in accordance with the forecasts made by the International Monetary Fund, as described above).

2. The added value growth per employee

Calculation methodology and calculated estimate value

Often, a project may not be aimed at creating new jobs but at developing new products, carrying out the production or process innovation or entering new markets without the objective of creating new jobs. In such a case, the net benefit to society is not a new job created as a result of project implementation, but the increase in the added value created by the same person. For example, the company has created a new product by using open access to RDI infrastructure, and the manufacture of the product is performed in an existing branch of the company. The new product will be manufactured by the same staff, but they will create a greater added valuedue to more advanced technology and higher value of the new products.

In order to determine a general estimate of such a growth of the added value, it would seem most appropriate to apply the difference between the added value created in high value-added economic activities and the added value created in the remaining economic activities.

Table "M2010301: The Country's Economic Performance. Features: Type of Economic Activity (CEA 2)" published by the Lithuanian Department of Statistics includes data on the value-added per one employee according to the economic activity performed (CEA 2). The calculations of the estimate were based on data of the year 2011, as the latest data currently available reflects the situation in the year 2011. The estimates applicable to the year 2013 was calculated on the basis of the nominal GDP growth per 1 inhabitant (based on the data provided by theInternational Monetary Fund[323]).The calculations and the values of the estimates are presented in Table 92 .

Table 46. The value-addedgrowth per employee

Types of economic activities	VA per employee in 2011., LTL	VA per employee in 2012., LTL	VA per employee in 2013., LTL
B Mining and quarrying	145,000		
C10_TO_C12 Production of food, beverages and tobacco	91,500		
C13_TO_C15 Manufacture of textile products; manufacture of wearing apparel, leather and leather products	40,900		
C16_TO_C18 Manufacture of wood, paper and paper products; publishing and printing	73,000		
C22_C23 Manufacture of rubber and plastic products and other non-metallic mineral products	104,400		
C24_C25 Manufacture of basic metals and metal products, except machinery and equipment	66,300		
C31_TO_C33 Manufacture of furniture; jewellery, musical instruments and toys; repair and installation of machinery and equipment	65,800		
D Electricity, gas, steam and air conditioning supply	188,000		
E Water supply, sewerage, waste management and remediation activities F	60,300		
F Construction	66,900		
G Wholesale and retail trade; repair of motor vehicles and motorcycles	72,000		
H Transportation and storage	111,400		
I Accommodation and food services	34,500		
L Real estate activities	165,900		
S Other service activities	24,800		

[323] Source: http://www.imf.org/external/ns/cs.aspx?id=28.

Types of economic activities	VA per employee in 2011., LTL	VA per employee in 2012., LTL	VA per employee in 2013., LTL
AVERAGE (1)	**87,380**	**93,674**	**99,594**
The economic activities creating high added value (the value of the previously calculated estimate "1. The added value created per employee") (2)	**156,856**	**168,155**	**178,781**
THE ADDED VALUE GROWTH PER EMPLOYEE (2-1)	**69,476**	**74,480**	**79,187**

Source: developed by BGI Consulting and CSIL Milano.

Since the added value created over subsequent years should increase, the estimates of the CBA period, applicable to future years, must be recalculated according to the real GDP per capita growth. The calculations are equivalent to those provided in the case described above.

The comparison with other countries. See the estimate called "Added value created per employee ineconomic activities related to high and medium-high technology (HMHT)".

Application instructions

The estimate is applied in cases where a project is not be aimed at creating new jobs but at developing new products, carrying out the production or process innovation or entering new markets without the objective of creating new jobs. I.e., the net benefit to society is not a new job created, as a result of project implementation, but the increase in the added value created by the same person.

In order to calculate the annual additional added value that is created by companies due to the use of a developed infrastructure, the value estimated for a particular year is multiplied by the number of the employees, who, due to the implementation of the project, are going to manufacture a new product or provide new service. For the purpose of applying an estimate, it is necessary to take into account the following aspects:

- The planned number of companies that will benefited from the infrastructure created, must be realistic. It is recommended that the realism of the number undergo a consultation with experts knowledgeable over the most relevant sectors of the project;
- The planned impact of a developed infrastructure leading to changes of companies' activities could be assessed already during the preparation of the feasibility study. I.e., the assessment should include not only the number of companies that will take advantage of the infrastructure to carry out their activities, such as RDI activities, each year during the period in question, but also the number of employees that could be involved in the creation of a new product or provision of services developed. If the feasibility study does not provide such insights, it is advisable to consult with experts having significant knowledge about the most relevant sectors of the project;
- When applying a fixed estimate, benefits gained due to the indirectly created jobs should not be additionally assessed, as this would cause the risk of double-counting of the benefits. This is based

on the standpoint of the EC Guidelines of 2008 that usually the indirect jobs are created by transferring operations from other areas (i.e., other areas experience benefit (damage)).

The following is an example of the value-added growth per employee estimate application.

Insert 34. Example of the value-added growth per employee estimate application.

For example, during the implementation of the project, open access to RDI infrastructure will be created. It is planned that every year 10 companies will make use of the infrastructure in order to develop technologically advanced products. Expert opinion has shown that, taking into account the size of the companies interested, their positions in the market and the expected new product innovation degree, one company will appoint, on average, up to 5 employees to manufacture a new product during the first year of the production (in later years, with the strengtheningpositions of the product in the market, additional staff would be appointed until, in the end, the product technology will become outdated and the company will introduce a new product). Let's say that expert opinion has also shown that the period from the start of the RDI activities to the start of manufacture of the product on average lasts for 2 years. In this way, if 10 companies started RDI activities under the project from the first year of project operation, 50 employees (10 companies * the above-mentioned 5 employees) would start manufacturing new products in the third year of the project implementation. Thus, the benefit received in the third year of the project operation due to the added value growth is equal to: 50 employees * the value of the estimate of the years in question.

Source: developed by BGI Consulting and CSIL Milano.

In cases where the researchers conducting the feasibility study have more accurate data on the economic activity performed by the companies in question or the size of the added value created, it is appropriate to apply a specific value of the estimate, but in this case strong arguments must be presented in support of this choice. The following is an example of the situation where it is appropriate to apply a specific estimate:

Insert 35. Example of the application of the value of the value-added growth estimate per employee.

For example, during the implementation of the project, open access to RDI infrastructure will be created. It is planned that this infrastructure will only be used by manufacturers of chemicals and chemical products. Supposethe expert opinion indicates that technologically more advanced products, created by using the infrastructure in question, will allow to increase the added value per employee by 20%. In this case, it would be appropriate to usethe added value per employee as a starting point for the economic activity "C20 Manufacture of chemicals and chemical products", and the value of a specific estimate would be equal to 20% of the added value. A specific estimate should be multiplied by the planned number of staff that will manufacture new products.

Source: developed by BGI Consulting and CSIL Milano.

Estimate update instructions

The Estimate update instructions are analogous to those applicable to the above calculation of "The added value per employee".

3. Carbon dioxide (as a greenhouse gas) emissions increase

As provided in the EC Guidelines of 2008 the increase in carbon dioxide, as a greenhouse gas, emissions are caused by the production activities launched or developed due to investment.

In addition, greenhouse gas emissions are distinguished in the EC Guidance of 2008 as a component of damage caused by congestion that can result from investment in industrial zones and technology parks. For example, the already intense traffic became even heavier when a public infrastructure for business was created and developed in Saulėtekis (Vilnius).

This component of socio-economic impact, as well as its, estimates are the same as those described in the sections on transport and energy.

The component and its estimates application to the sector of public infrastructure for business

The instructions for estimate application are similar to those described in the sections on transport and energy.

The impact of the project on the amounts of GHG emitted should be defined in the feasibility study according tosimulation results. Generally, the impact of the project onthe amounts of GHG emitted can be found in the project's environmental impact assessment report. This amount should be multiplied by a unit estimate in order to calculate the monetary value of the impact.

4. Time losses due to increased traffic congestion

As stated in the EC Guidelines of 2008, investment in industrial zones or technology parks may lead to additional costs due to increased traffic congestion, including time losses. I.e., individuals, who used to travel through the project area in question before the project implementation, will experience time losses (during the construction phase due to traffic restrictions, as well as during the operation due to the increased flow of passengers).

This component of socio-economic impact and its estimates are the same as those described in the section on transport.

The component and its estimates application to the sector of public infrastructure for business

Time losses due to increased traffic congestion are likely to occur only if the project is carried out in the area with large traffic flows. For example, the already intense traffic became even heavier when a public infrastructure for business was created and developed in Saulėtekis (Vilnius). It should also be noted that the global effect, which should be analysed, can be both positive and negative. Often, the net impact on the public is negligible. This can be illustrated by the example provided in the EC Guidelines of 2008, which shows how the negative impact of increased traffic flows resulting from the industrial zone project is indemnified by newly built roads that are necessary for the industrial area.

The instructions for estimate application are similar to those described in the section on transport. In order to calculate the benefits arising from the travel time savings, the unit value of the estimate provided in the section on transport must be adapted to passengers and not vehicles. If the traffic information available covers only vehicles, the number of vehicles should be converted into the number of passengers using the average number of passengers travelling in a vehicle, which in Lithuania is 1.2 passengers per car[324].

Impact on congestion should be provided in a feasibility study of a specific project.

5. Air pollution increase due to increased traffic congestion

As mentioned above, investment in industrial zones and technology parks may lead to additional costs due to increased traffic congestion, including air pollution costs.

This component of socio-economic impact, as well as its estimates, are the same as those described in the section on transport.

The component and its estimates application to the sector of public infrastructure for business

The instructions for estimate application are similar to those described in the section on transport.

The Project’s impact on the levels of different pollutants emitted should be defined by the feasibility study according to simulation results. Generally, the impact on the levels of pollution can be found in the project's environmental impact assessment report. These levels should be multiplied by unit estimates in order to calculate the monetary value of the impact.

[324] According to the data of PI Road and Transport Research Institute

1.13.4. Table of the socio-economic impact estimates of the sector of public infrastructure for business

To summarize, the determined socio-economic impact estimates are provided in tabular form (Table 93) set out in Terms of Reference.

Table 47. The socio-economic impact estimates established for the sector of public infrastructure for business

<table>
<tr><th>Sector</th><th>Conversion factors*</th><th>Quantitative assessment of the conversion factor*</th><th>Minimum workload (table of strong, reliable and significant ratings (at least three)</th><th>Quantitative expression, LTL</th></tr>
<tr><td>Public infrastructure for business</td><td>n/a</td><td>n/a</td><td>1. The added value per employee</td><td>178,781 LTL,applying prices of 2013</td></tr>
<tr><td>Public infrastructure for business</td><td>n/a</td><td>n/a</td><td>2. The added value growth per employee</td><td>79,187 LTL, applying prices of 2013</td></tr>
<tr><td>Public infrastructure for business</td><td>Energy</td><td>Fuel excise duties are intended to reflect the negative impact of climate change. Since the conversion factors applicable to energy eliminate the above mentioned tax, the estimate applicable to greenhouse gases does cause risk to double-counting of</td><td>3. Carbon dioxide (as a greenhouse gas) emissions increase</td><td>C0$_2$ tonnes converted in LTL:
<table>
<tr><th rowspan="2">Application year</th><th colspan="3">The central value</th></tr>
<tr><th>The lower value</th><th>The central value</th><th>The lower value</th></tr>
<tr><td>2010–2019</td><td>28</td><td>86</td><td>169</td></tr>
<tr><td>2020–2029</td><td>59</td><td>138</td><td>242</td></tr>
<tr><td>2030–2039</td><td>76</td><td>190</td><td>345</td></tr>
<tr><td>2040–2049</td><td>76</td><td>242</td><td>466</td></tr>
<tr><td>≥2050</td><td>69</td><td>293</td><td>622</td></tr>
</table>
</td></tr>
</table>

Sector	Conversion factors*	Quantitative assessment of the conversion factor*	Minimum workload (table of strong, reliable and significant ratings (at least three)	Quantitative expression, LTL
		benefits or harm.		
Public infrastructure for business	n/a	n/a	4. Time losses due to increased traffic congestion	The value of time (applying prices of 2013): • For a work passenger: 29.33 LTL/hr.; • For a non-work passenger : 11.73 LTL/hr.; • For freight transport: 11.35 LTL per hour, per tonne of cargotransported
Public infrastructure for business	n/a	n/a	5. The increase in air pollution due to traffic congestion	**LTL per one tonne of pollution emitted:** • NOx – 15,638; • NMVOC – 1,738; • SO_2 – 20,850; • SP2.5: o City – 1,243,209; o Town – 403,978; o Village – 248,468; • SP10: o City – 496,936; o Town – 161,591; o Village – 99,040.

Notes:

* Table of indicators should be associated with the conversion factors established by a service provider to ensure that the calculation will not be double-counting of harms and benefits.

1.13.5. Annexes (the sector of public infrastructure for business)

Annex 1. The benefit (damage) components applicable to different types of projects

Project type	Applicable benefit (damage) components*
1. Investment in the development of the infrastructure necessary for business in connection with RDI, and updating of the existing infrastructure	1. The added value per employee 2. The added value growth per employee 3. The increase in greenhouse gas emissions 4. Time losses due to increased traffic congestion 5. The increase in air pollution due to traffic congestion
2. Investment in the infrastructure necessary for business in connection with the development of activities	1. The added value per employee 2. The added value growth per employee 3. The increase in greenhouse gas emissions 4. Time losses due to increased traffic congestion 5. The increase in air pollution due to traffic congestion

* Not all socio-economic impact (benefit and harm) components may be relevant to a specific project.

Annex 2: Demand analysis

When predicting the number of jobs that will be created in companies taking advantage of the public infrastructure, it is appropriate to analyse the distribution of such companies according to the following categories (the categories are exemplary, which means that, depending on the situation, different categories might be analysed):

- Foreign companies that are looking for the most favourable conditions for their development and choose from several countries, perhaps even from countries in different continents. If such a company chooses to invest in Lithuania (and not in another country) due to the public infrastructure for business, developed within the project framework, all jobs, created using the public infrastructure developed within the project framework, are attributed to the impact of the project;
- Foreign companies that would invest in Lithuania in any event, but they decideto use the infrastructure, created within the project framework, which has obvious advantages compared with another public infrastructure existing in Lithuania (for example, they decide to locate in the free economic zone, and not in another area). In this case,it must be examined whether the company will create additional jobs due to the exercise of the public infrastructure createdwithin the project framework, compared to the situation where the company would have invested in another area. Only additional jobs created are attributed to the impact of the project;
- Companies operating in Lithuania (regardless of the origin of the capital), which, in the absence of access to the public infrastructure for business, created within the project framework, would not carry out their development in Lithuania. In this case, all the jobs created due to the infrastructure developed within the project framework are attributed to the impact of the project;
- Companies that would invest in Lithuania in any event, but they decide to use the infrastructure, created within the project framework, which has obvious advantages compared with another public infrastructure existing in Lithuania. Only additional jobs created are attributed to the impact of the project to compare with a situation where the company would have invested in another area;
- Regardless of the business type distinguished, a project may not be aimed at creating new jobs but at developing new products, carrying out the production or process innovation or entering new markets without the objective of creating new jobs. In such a case, the net benefit to society is not a new job created as a result of project implementation, but the increase in the added value growth created by the same person. For example, the company has created a new product by using open access to RDI infrastructure, and the manufacture of the product is performed in an existing branch of the company. The new product will be manufactured by the same staff, but they will create a greater added value due to more advanced technology and higher value of the new products.To reflect this value-added growth, it is proposed to use a uniform estimate (the difference between the added value created in high value-added economic activities, and the added value created in the remaining economic activities).

Depending on the situation and the information available, the categories in question may be different. It should be noted that, generally, it is not known in advance which companies will use the planned public infrastructure for business. Therefore, individuals preparing a feasibility study should rely on the factual information provided in previously executed similar projects about the composition of the companies that used the infrastructure and, if possible, convey the companies survey to find out how their development and the number of created jobs was influenced by the created public infrastructure for business.

It is also necessary to plan a realistic utilization of the capacity of the created infrastructure. During the firstfew years of the developed infrastructure's operation,its utilization rates are generally low, for example, first companies are established in the industrial area, i.e., first hectares are leased. Over the years, the level of utilization of the infrastructure grows. For the purposes of creating such a forecast, researchers can rely on the factual information of previously executed similar projects.

When analysing industrial areas and related infrastructure, it is also important to consider the number of jobs that can be created per hectare. It depends on a company's economic activity, but a reasonable estimate can be determined on the basis of the factual information of previously executed similar projects and / or in consultation with experts having significant knowledge about the sectors, where the attraction of companies is most likely to occur.

In the case of an infrastructure necessary for business, related to RDI, when predicting the number of jobs being created and their development dynamics, it is appropriate to consult with experts having significant knowledge about the most relevant sectors of the project.

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