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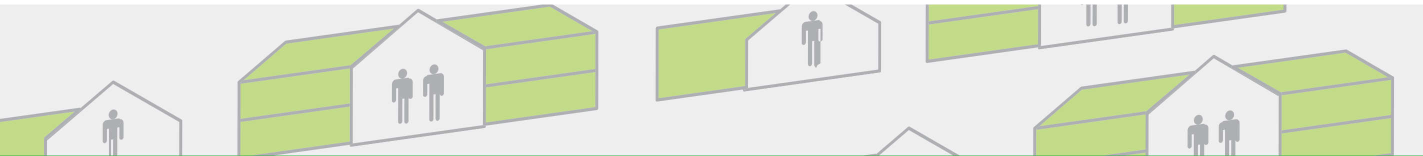

Study on the macroeconomic impacts of energy efficiency measures in schools and kindergartens in Serbia

Serbian-German Cooperation Project
“Energy Efficiency in Public Buildings in Serbia”
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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STUDY ON THE MACROECONOMIC IMPACTS OF ENERGY EFFICIENCY MEASURES IN SCHOOLS AND KINDERGARTENS IN SERBIA

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1. Executive summary

In order to reduce energy consumption in the building sector, public policies have been developed across the EU to encourage building owners to implement energy efficiency measures. The public sector is required to lead by example, by providing “best practice” cases. As a member of the EU Energy Community, Serbia has committed itself to implementing step by step the energy relevant chapters of the acquis communautaire, thus introducing requirements concerning the energy consumption in buildings.

Improving energy efficiency can deliver a range of benefits to the economy and society. However, energy efficiency programmes are often evaluated only on the basis of the energy savings they deliver. Consequently, the full value of energy efficiency improvements may be significantly underestimated.

The objective of this study is to assess the potential macroeconomic impacts of energy efficiency measures targeting schools and kindergartens in Serbia. The study focuses on GDP, employment and public budget effects of investments in energy efficiency improvement. Understanding of such multiple impacts could be beneficial to policy-makers by providing them with the wider picture of the benefits of such investments.

School and kindergarten building stock. There are 3,890 schools and 2,591 kindergartens in Serbia (2016), with a total floor area of 7,368,104 m^2. Final energy consumption for heating and domestic hot water is estimated at 1,975 GWh/a, which corresponds to 268 kWh/m^2 annually.

Renovation scenarios. The macroeconomic impact of energy efficiency improvement programmes is determined by the scale and depth of the renovation undertaken. The study investigated the potential impact of four renovation scenarios, with varying degrees of renovation speed and scope. Two different scenarios were considered regarding renovation rate: *Slow renovation scenario* (assumes an annual renovation rate of 2% of the total floor area, which equals 147,362 m^2 per year), and *Fast renovation scenario* (assumes an annual renovation rate of 5% of total floor area, i.e. 368,405 m^2 per year). Regarding the scope of renovation, two scenarios were considered: *Improvement 1 scenario* (energy efficiency measures refer only to the thermal envelope of the building, without changes to heating system and fuel), and *Improvement 2 scenario* (assumes a deep retrofit of thermal envelope of the building and a switch to wood biomass as a fuel, except in the case when the school/kindergarten is connected to district heating and the heating plant operates on natural gas as a fuel).

Potential savings. Energy efficiency improvements in schools and kindergartens would lead to substantial savings, both in consumed energy and money paid for energy bills. Instead of current use of 268 kWh/m^2 annually, 184 kWh/m^2 of final energy would be required in the case of *Improvement 1 scenario*, or only 69 kWh/m^2 in the case of *Improvement 2 scenario*. This represents 31%, or 74% of energy savings, respectively.

Renovation of the total building stock of Serbian schools and kindergartens would lead to a reduction in final energy consumption from current 1,975 GWh per year, to 1,357 GWh/a in the case of *Improvement 1 scenario*, or 507 GWh/a in the case of *Improvement 2 scenario*. This represents a decrease in the energy consumption by 618 GWh/a, or 1468 GWh/a, respectively.

With the difference in assumed renovation scenarios, every year after the start of the renovation programme additional 12 to 73 GWh of the final energy could be saved.

Expressed in monetary terms, the renovation of the total building stock would lead to reduced energy costs amounting to EUR 37 million annually in the case of *Improvement 1 scenario*, i.e. EUR 72 million in the case of *Improvement 2 scenario*. Given the different rates of renovation, additional EUR 0.73 to 3.61 million would be saved every year due to energy efficiency improvements after the start of the retrofit programme.

Investment volumes required. The necessary investments volume for energy efficiency improvement measures in schools and kindergartens in Serbia are estimated at 65 eur/m^2 in the case of *Improvement 1 scenario*, and at 146 eur/m^2 in the case of *Improvement 2 scenario*.

The annual investment volume would amount to EUR 9.6 to 53.9 million, depending on the renovation scenario. The total investment volume for the renovation of the whole building stock is estimated at EUR 480 million in the case of *Improvement 1 scenario*, and at EUR 1,078 million in the case of *Improvement 2 scenario*.

From a fiscal point of view, the pay back period for investments in school and kindergarten energy efficiency improvements would be 18 years in *Improvement 1 scenario*, and 21 years in the case of *Improvement 2 scenario*.

Effects on employment. Investments in the improvement of energy efficiency in schools and kindergartens in Serbia would create up to 1,132 new jobs in the construction sector during the investment period (direct effect), depending on the renovation scenario. However, due to the indirect and induced effects, the total job creation effect would sum up to 2,433 new jobs.

Effects on GDP. The estimations show that the Serbian GDP would increase by EUR 8 up to 45 million each year during the investment period, depending on the renovation scenario. The estimated GDP increase would contribute to the growth of Serbian GDP by additional 0.12 percentage points. This is a one-off shift effect during the investment period.

Effects on Public Budget. It is estimated that annual revenues in the central government's budget would increase by EUR 1.6 up to 9 million during the investment period, depending on the renovation scenario, due to the increase in overall investments and economic activities.

Municipal budgets would also benefit from the increased economic activity, with an estimated increase in the local public budget revenues of up to EUR 0.97 million.

Policy recommendations. Considering all positive macroeconomic effects, the study demonstrates that it is important for the government to support a renovation programme aimed to increase the energy efficiency improvements in schools and kindergartens across the Republic of Serbia. The study has shown that the government also has economic justification for providing financial incentives for energy efficiency improvement programmes, as the increase in the budget revenues due to such programmes equals approximately 22% of total investment needed.

By providing wide support to energy efficiency improvement programmes, Serbian government could unlock a significant potential for creating additional jobs and boosting economic activity in the country.

2. Introduction

As a member of the EU-Energy Community (EnC) Serbia has committed itself to implementing step by step the energy relevant chapters of the acquis communautaire and transpose relevant EU directives, thus introducing requirements concerning the energy consumption of buildings.

In order to reduce energy consumption in the building sector, public policies have been developed across the EU to encourage building owners to implement energy efficiency measures. Article 4 of the EED (DIRECTIVE 2012/27/EU of 25 October 2012 on Energy Efficiency) requires member states to define long-term strategies to stimulate renovations in their building sectors.

Article 5 of EED requires public sectors to lead by example, and by providing “best practice” cases. The EED sets a 3% annual renovation target for public buildings owned and occupied by its central government from the beginning of 2014 onwards. For Serbia, as for the other EnC contracting parties, the target is set at 1% renovation rate annually.

Serbia has a very significant energy savings potential. Poor energy efficiency and high carbon intensity due to heavy reliance on fossil fuels represent two main challenges faced by the Serbian energy sector.

Improving energy efficiency can deliver a range of benefits to the economy and society, which reach beyond energy savings and greenhouse emission reductions. For example, there are significant positive macroeconomic impacts such as GDP and employment rate growth, enhanced trade balance and energy security. These can in turn have a significant impact on the national and municipals budgets. It is important to recognize these benefits in the programme design and evaluation so as to have a full view of the impacts.

However, energy efficiency programmes are often evaluated only on the basis of the energy savings they deliver. Consequently, the full value of energy efficiency improvements may be significantly underestimated. A clear understanding of the multiple impacts that energy efficiency improvements could have on the economy would be beneficial to policy-makers (both at national and local levels) by providing them with a wider picture of the benefits of such programmes would deliver.

While the public sector buildings represent a smaller share of the overall building stock than, for instance, residential buildings, they are still amongst the least efficient of any building category. This provides a strong rationale for the project to focus on public buildings. Many public buildings were constructed 40 or 50 years ago. In most cases, thermal properties of the building envelope, including walls and windows, are poor thus resulting in high heat losses and related heat demand. The heat generation systems in public buildings are typically outdated and inefficient without a proper regulation and automation systems. Electricity is used for domestic hot water. For lighting, many public buildings are still using inefficient incandescent light bulbs or outdated fluorescent tubes with inefficient starters. Since there were no large scale renewals of these buildings for decades, their overall condition, both in terms of physical condition, comfort issues and energy efficiency can be estimated as poor (Fabbri et al, 2016).

The objective of this study is to assess the potential impacts of energy efficiency measures in schools and kindergartens in Serbia on employment and GDP at the national level, as well as on public budgets.

The study is organised as follows. The next section provides background information about the current status and trends in energy efficiency in the Republic of Serbia compared to the EU28 as well as an overview of macroeconomic effects of energy efficiency improvements in buildings. Section 4 explains the methodology used in this study for the estimation of the macroeconomic effects of energy efficiency improvement in Serbian schools and kindergartens. Section 5 provides data on the Serbian school and kindergarten building stock and their current energy consumption. Furthermore, this section defines possible renovation scenarios, which will be used as a basis for the estimation of the macroeconomic effects of the retrofits. Potential savings due to the improvement of energy efficiency in schools and kindergartens in Serbia as well as the investment volumes needed for such improvements are estimated in Section 6. Section 7 presents estimations of effects of such energy efficiency improvements in Serbian schools and kindergartens on national GDP, employment and public budgets. Section 8 offers conclusions and recommendations to policy-makers.

3. Background

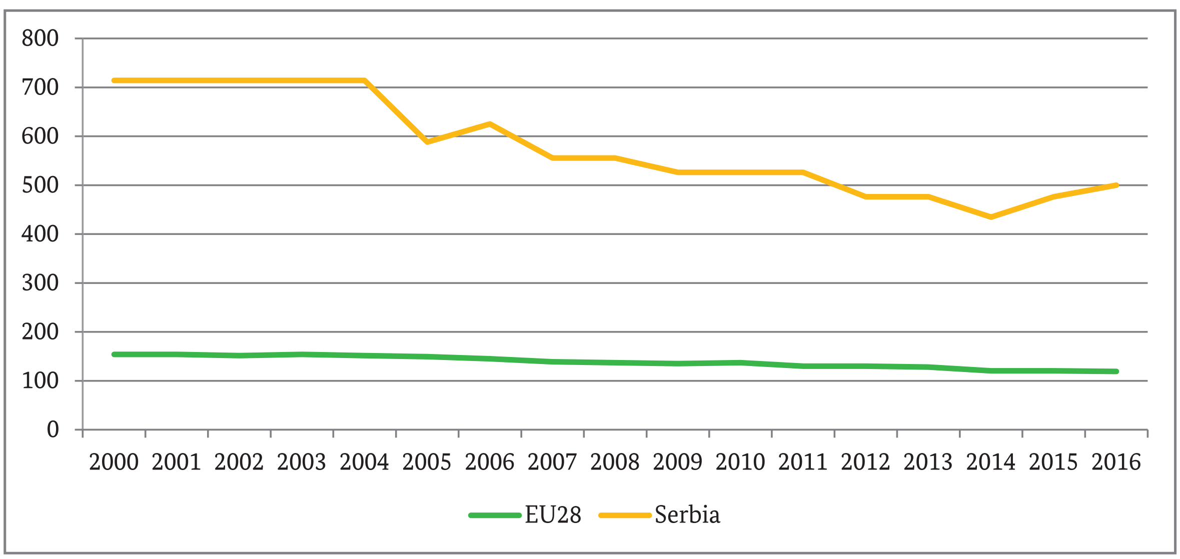
3.1. Trends in energy efficiency in Serbia

Energy intensity is defined as ratio between the gross energy consumption and gross domestic product (GDP) for a given calendar year. The gross consumption of energy is calculated as the sum of the gross consumption of five energy carriers: coal, electricity, oil, natural gas and renewable energy sources. This indicator identifies the extent of decoupling between energy consumption and economic growth. Relative decoupling occurs when energy consumption grows, albeit more slowly than the economy (i.e. gross domestic product). Absolute decoupling occurs when energy consumption is stable or falls while GDP grows. An absolute decoupling is likely to alleviate the environmental pressures from energy production and consumption (EEA, 2015).

Analysing energy intensity as an indicator identifies the extent of relative decoupling between energy consumption and economic growth, but it does not show the absolute decoupling or any of the underlying reasons that affect the trends. Reduction in total energy intensity can be the result of positive improvements in energy efficiency or changes in energy demand resulting from other factors including structural, societal, behavioural or technical change.

Chart 3.1 presents the trends in energy intensity in the EU28 and Serbia in the period 2000-2016, based on Eurostat database. Energy intensity is here defined as division of the gross inland consumption of energy for a given calendar year by the economic output of the country. The economic output is given in Euros in chain-linked volumes to the reference year 2010 at 2010 exchange rates. The chart clearly shows that Serbia lags considerably behind the EU28 average in terms of energy efficiency. In 2016, the energy intensity in the EU28 was 4.2 times higher than in Serbia.

Chart 3.1. Energy intensity (kgoe per 1,000 EUR) in EU28 and Serbia, 2000-2016



Source: Eurostat data

Both EU and Serbia show declining trends of energy intensity in the observed period. Energy intensity in the EU28 has constantly declined since 2000, with an average annual rate of 1.7%. In Serbia, the observed decline was even sharper until 2014 (3.3% annually on average), but the trend reversed in the past years.

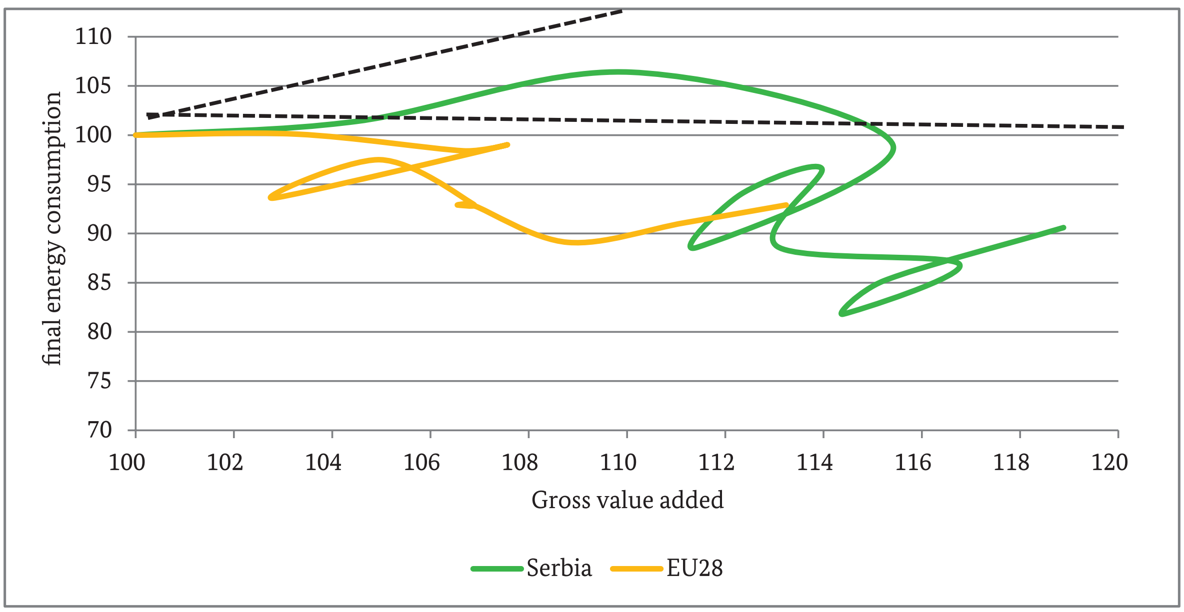
To obtain a more detailed insight into decoupling economic output from energy consumption, the existence of absolute decoupling should be examined. Chart 2.2 shows development of final energy consumption and gross value added for the EU28 and Serbia between 2005 and 2016.

The area in the upper right between the two dashed lines represents relative decoupling: gross value added grows faster than final energy consumption, while both indicators exhibit positive growth. This indicates increasing energy efficiency in the overall economy.

Values in the area below the horizontal dashed line and right of the bisecting dashed line imply absolute decoupling, a situation in which economic development is decoupled from energy consumption, while final energy consumption is decreasing in absolute terms.

The area left of the bisecting dashed line indicates no decoupling, i.e. final energy consumption growth rate exceeds gross value added growth rate.

Chart 3.2 Development of final energy consumption and gross value added in EU28 and Serbia between 2005 and 2016 (2005=100)



Source: Eurostat data

Chart 3.2 shows that the EU28 decoupled its economic development from energy use in absolute terms, as gross value added has grown (except during the Great Recession), while final energy consumption has been decreasing at the same time.

Serbia, on the other hand, has been experiencing only relative decoupling over the period 2005-2008, while absolute decoupling occurred since then. However, the development presented in Chart 2.4 is not totally favourable. The strong decrease in final energy consumption in Serbia went hand in hand with a decline in gross value added. A decoupling development would be more favourable if Serbia were able to decrease not only its final energy consumption but also to increase gross value added at the same time.

At the end of 2015, National Assembly of the Republic of Serbia adopted the "Energy Sector Development Strategy of the Republic of Serbia for the Period until 2025 with projections by 2030". Inter alia, the Strategy promotes energy efficiency in Serbia, by introducing measures aimed to reduce the consumption of final energy in accordance with the obligations assumed under the Energy Community Treaty and Directive 2006/32/EC on Energy Efficiency regarding final consumption and energy services. While the economic development strategy of the Republic of Serbia is based on reindustrialisation and high growth of industry, which will certainly lead to increased energy consumption, the strategy emphasises "the intensive implementation of measures and activities for improvement of energy efficiency (in order to) to secure that indicators of energy efficiency (expressed in monetary and natural values) lead to average values as in the countries of the European Union (EU)".

3.2. Macroeconomic benefits of energy efficiency improvements in buildings

The International Energy Agency (IEA) report "Spreading the net: the multiple benefits of energy efficiency improvements" (Ryan, L. and N. Campbell, 2012) describes the wider socio-economic outcomes that can arise from energy efficiency improvement, aside from energy savings. Outcomes are produced at different levels of the economy: at individual level (individuals, households and enterprises); at sector level (by economic sector such as transport, residential, industrial sectors); at national level (including macroeconomic benefits, and benefits to national budgets); and at international level (reflecting the international public good character of such benefits). In accordance with the objective of this study, impacts of the energy efficiency improvements in buildings on GDP, employment and public budgets are going to be described in this section.

3.2.1 GDP and employment

The implementation of energy efficiency measures in buildings increases investments in goods and services, which are components of GDP. At the same time, energy efficiency improvements lead to reduced energy bills. As energy bills for schools and kindergartens in Serbia are paid by local governments, the estimated monetary savings would represent decreased expenditures for local, municipal budgets.

The GDP growth due to increased production of goods and services associated with investments into energy efficiency improvements represents a direct effect on national income. The total effects on GDP, however, do not stop here. The indirect and induced effects should be considered, too. The indirect effect arises when supply chains connected with the production of energy efficiency related goods and services increase the national production volume in Serbia. Additionally, the induced effect results from increased income from direct and indirect production activities which is then spent across all sectors of the economy. The induced effect is a result of second and third round of new income re-spending, i.e. the income multiplier effect.

As in the case of GDP, total employment effects of energy efficiency improvements include direct, indirect and induced job creation.

Direct job creation appears in the sectors producing goods and services associated directly with energy efficiency improvements (production of insulation materials, energy efficient joinery, energy efficient appliances and so on, for example).

Indirect jobs are generated further upstream in the supply chain. The value of created jobs depends on various factors such as their labour intensity, local content, wage rates (Pollin, Heintz and Garrett-Peltier, 2009) and the time period over which the energy efficiency improvement programme is implemented.

As a result of new income created in the construction sector and other sectors upstream in the supply chain, new jobs and income could be created across all sectors in the economy (induced effect). The scope of this effect depends on the value of the national economic multiplier.

When evaluating the employment effects of energy efficiency improvements in buildings at national level, the displacement effect has to be taken into serious consideration. Increased production and employment in sectors related to energy efficiency product and services could be followed by a decrease in the production and employment in traditional energy production sectors. If this is going to be the case, it will depend on domestic vs. imported content of relevant goods, services and fuel production, and on the labour intensity of these production activities.

3.2.2. Public budget

The public sector, particularly municipalities, can benefit from implementing the energy efficiency measures. As energy efficiency policy measures are defined by the national, local or municipal governments, and as policy measures in most cases include financial and fiscal incentives, the interest of policy-makers for comprehensive cost-benefit studies for public budgets is reasonable and expected. As in the case of GDP and employment, public budget impacts from energy efficiency improvements also arise from increased investments and reduced energy consumption.
Energy efficiency investments in buildings and energy consumption reduction might have impacts on both budget revenues and budget expenditures. The most obvious impact of implementation of

public measures in the field of energy efficiency improvements in public buildings is reflected in the growing public spending (and budget expenditures). However, the impact of energy efficiency improvements on the public budget does not end here.

Energy efficiency measures in buildings could have a number of positive impacts on public budgets (both at national and local levels). As shown, energy efficiency improvements in buildings can boost economic activity, lead to higher GDP growth rates and create new jobs. These effects clearly lead to a rise in public budgets revenues through increased collection of sales and income taxes. On the other hand, downsized investments in traditional public energy infrastructure, as well as lower public expenditure on public sector energy consumption reduce the budget expenditures. These effects can be considerably high in countries with large public sectors, as it is the case of Serbia. Given that energy bills of Serbian schools and kindergartens are paid by municipalities, energy efficiency improvements in the schools and kindergartens would enable municipalities to spend more on other issues, like education, child care or similar. However, this depends on how the energy efficiency investments are financed. If the investment is financed by the local government, there will be no additional funds available for other purposes, until the investment is paid back.

3.2.3. Rebound effect

A study on the macroeconomic effects of energy efficiency improvements should take into account the so called rebound effect. The rebound effect is defined as the increase in energy demand that may occur as reduced energy bills boost disposable income (the 'income effect') while lower prices prompt a substitution by other energy-consuming activities (the 'substitution effect'). While the income effect for energy efficiency is unambiguously welfare-enhancing, boosting consumer purchasing power, the phenomenon can lead to questions about the validity of energy efficiency improvements in the context of economy-wide GHG reduction (Holmes, I. and R. Mohanty, 2012).

Distinction between three types of rebound effects is made (Ryan, L. and N. Campbell, 2012):

- ***Direct rebound*** occurs when a consumer or producer who reduces their energy costs by investing in energy-efficient activities chooses to increase energy consumption using saved money.
- ***Indirect rebound*** occurs when consumers and businesses invest the savings generated by energy efficiency improvements in other goods. The indirect rebound effect is more difficult to identify and analyse than the direct rebound effect, thus resulting in fewer comparable studies.
- ***Macroeconomic or economy-wide rebound*** occurs when improved energy efficiency leads to increased energy productivity and economic growth. This effect is the least well-documented and is the subject of misinterpretation.

The scope of rebound effect has been studied in literature and the vast majority has concluded that it does exist but is not strong enough to outweigh the energy and financial savings resulting from energy efficiency. Nevertheless, rebound factors can mitigate the scope of energy efficiency improvement benefits and should be factored into policy planning and effects evaluation.

4. Methodology

The aim of this study is to estimate the potential effects of energy efficiency improvements in educational buildings (schools and kindergartens) in Serbia on GDP, employment and public budgets. This implies the assessment of the overall (total) effect, which consists of the direct, indirect and induced effects. The methodological approach applied in this study is described in this section.

4.1. Assessment of direct, indirect and induced effects

There are three main methodologies for assessing macroeconomic impact of energy efficiency that can be found in the relevant literature:

- The ratio approach, or employment factor approach (EFA),
- Input-output analyses (IOA), and
- Complex models (CGE models, etc.).

The main limiting factor underlying the selection of appropriate methodology is the availability of data. As there are no input-output tables for the Serbian economy available, the employment factor approach (ratio approach) will be used in this study for the estimation of direct effects.

This method is quite a popular approach in the literature studying the macroeconomic effects of development of renewable energy sector or energy efficiency improvements. The basic idea is to identify employment factors, i.e. labour intensities of different technologies or economic activities. Employment factors are usually derived from industry studies and literature reviews, which will also be the case in this study.

Employment factors are often calculated only to the direct employment effects, i.e. jobs associated with direct activities to save energy, taking no account of the indirect effect (job creation in supply chain) or induced effects resulting from the energy savings spending elsewhere in the economy (multiplier effect). In cases where the ratios are used to generate national data, such is the case in this study, these displacement and multiplier effects could be substantial, although they are difficult to measure (Cambridge Econometrics, 2015).

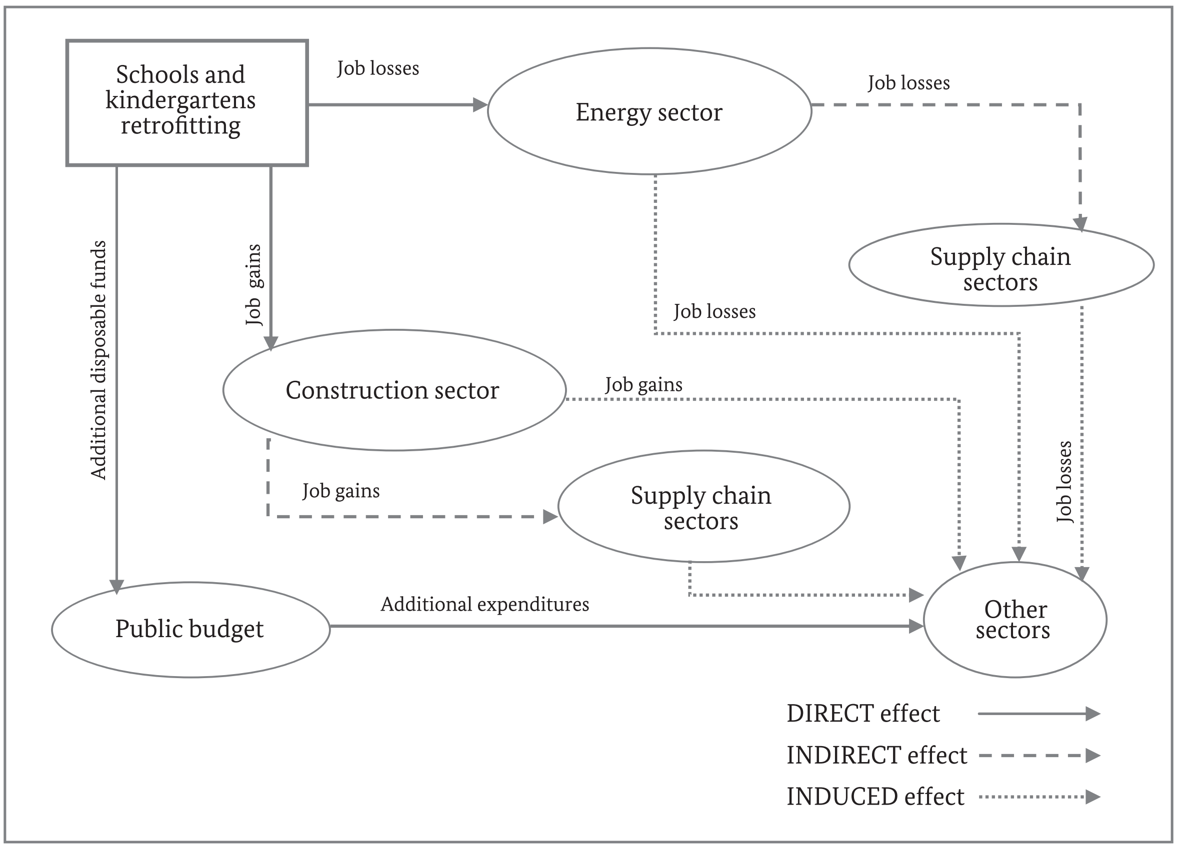
Indirect and induced effects of energy efficiency improvement programmes are estimated based on the multiplier concept. The key insight of the multiplier concept is that the national income increases by more than the initial investment expenditure. As investments enter economy, demand for labour and material will increase. Staff working at the project and firms selling goods and services required for the project will further on stimulate demand for other goods and services as they spend their earnings.

The standard approach to calculating the economic multiplier at national or regional level is to use input-output tables. However, as those tables are not available for the Serbian economy, an alternative approach should be used. One of them is Local Multiplier 3 (LM3) method, based on surveys of companies and their employees to establish their spending patterns. For the purpose of this study, this methodology is used to estimate expenditure multiplier in the construction industry in Serbia. A detailed description of the methodology used for the assessment of this multiplier is enclosed in Appendix 2. The estimated multiplier is then used to assess the total net employment effect.

GDP effect is estimated based on the employment effect translated into the gross domestic product via labour productivity.

Chart 4.1 presents the methodology used to assess the job creation effects of energy efficiency improvements in Serbian schools and kindergartens.

Chart 4.1. Employment effects



Source: Author

4.2. Employment factor selection

The direct net employment effect of investments in schools and kindergartens buildings retrofits in Serbia will be estimated in this study based on the employment factors.

Table 4.2 provides an overview of the employment factors estimated in studies on energy efficiency worldwide expressed in direct job creation per million euro invested in energy efficiency.

Table 4.2. Review of the employment factors in the literature

Study	Country/region	Employment factor	intervention
Wade et al., 2000	EU	26.60 jobs/Meur	Energy efficiency
CECODHAS, 2009	Europe	21.25 jobs/ Meur	Building retrofits
Pollin, Heintz and Garrett-Peltier, 2009	USA	16.60 jobs/ Meur	Building retrofits
European Climate Foundation, 2010	Hungary	26.00 jobs/Meur	Building retrofits

Source: selected studies

Table 4.2 shows that employment factors tend to vary across studies. They range from 16.60 jobs/ Meur to 26.60 jobs/Meur. As employment factors serve as a main input for the assessment of employment, GDP and public budget effects, the results are highly sensitive to the choice of factor.

The majority of these studies have been conducted in developed countries. Similar studies would probably hold different results if applied to transitional economies or to developing economies. In such countries, the labour intensity is typically higher, as the cost of labour is lower and often more affordable than automated means of production (Rutovitz and Atherton, 2009). The estimation of direct employment effects in this study is based on the employment factor obtained in the study by European Climate Foundation (2010), i.e. 26 new jobs created, as it is most relevant for this study due to the facts that:

- it is estimated for Hungary in 2010 (which is also a European transitional economy),
- It is estimated for the building retrofit programme (same programme type as in this study).

While creating new jobs in the construction sector, investments in buildings retrofits would contribute to job loss in the energy production sector. As improvements in energy efficiency of residential buildings reduce demand for heating energy, this sector will be faced with job losses. Based on the Serbian energy sector productivity, it is assumed in this study that 5 jobs would be lost in energy production sector per every million Euros invested in improvements in energy-efficiency of schools and kindergartens in Serbia.

4.3. Data sources

This study is based on data obtained by the project "Energy Efficiency in Public Buildings in Serbia" implemented by GIZ.

Data on school and kindergarten building stock, current energy status, as well as the potential energy savings in case of retrofits are taken from the "National Typology of School Buildings in Serbia" and "National Typology of Kindergartens in Serbia" (eds. M. Jovanovic Popovic, and D. Ignjatovic, 2018).

Data on the investments needed for energy efficiency improvements in school and kindergarten buildings and potential monetary savings are calculated based on the "Calculator for the analysis of energy efficiency measures in school buildings", as a result of the project "Energy Efficiency in Public Buildings in Serbia" implemented by GIZ.

5. Energy consumption and renovation scenarios in Serbian schools and kindergartens

Aiming to assess the current building stock of schools and kindergartens in Serbia and potential energy savings, University of Belgrade, engaged by DKTI EE project, created the "National Typology of School Buildings in Serbia" and "National Typology of Kindergartens in Serbia" (eds. M. Jovanovic Popovic, D. Ignjatovic, Deutsche Gesellschaft für Internationale Zusammenarbeit, 2018). According to these studies there are 3,890 schools and 2,591 kindergartens in Serbia until 2016, with the total net floor area of schools of 4,735,090 square meters and 2,633,014 square meters of kindergartens.

Within the national typologies, all school and kindergarten buildings are classified based on two criteria relevant for the energy consumption: size of the building (labelled from 1 to 3) and year of construction (labelled from A to D). Small buildings (up to 500m2) are labelled with "1", medium-sized buildings (500 to 2,000 m2) are labelled with "2", while large buildings (over 2,000 m2) are labelled with "3". Buildings constructed before 1945 are labelled with "A", buildings constructed between 1946 and 1970 are labelled with "B", buildings constructed between 1971 and 1990 are labelled with "C", while buildings constructed after 1990 are labelled with "D".

5.1. Building stock and energy consumption

Based on the national typologies of schools and kindergartens in Serbia, data on the number of buildings of each type, floor area and energy consumption for heating and domestic hot water, are given in Tables 5.1.1 and 5.1.2.

Table 5.1.1. Schools building stock and heating energy consumption (current status)

Cluster	Number	Net floor area	Total required heating energy	Total required energy for sanitary water heating	Total delivered energy	Total primary energy
		[m^2]	[GWh/a]	[GWh/a]	[GWh/a]	[GWh/a]
A1	596	98,340.00	30.80	0.98	60.30	12.21
A2	300	217,350.00	54.27	2.17	83.59	42.29
A3	242	555,148.00	131.63	5.55	169.28	201.07
B1	664	67,728.00	19.80	0.68	40.36	7.78
B2	449	390,630.00	74.88	3.91	131.09	50.53
B3	538	1,295,504.00	255.73	12.96	331.41	396.06
C1	337	64,367.00	20.48	0.64	39.27	8.65
C2	274	352,912.00	108.20	3.53	146.05	94.61
C3	413	1,287,321.00	247.04	12.87	329.26	279.24
D3	77	405,790.00	16.84	4.06	26.39	24.86
TOTAL	**3,890**	**4,735,090.00**	**959.67**	**47.35**	**1,357.00**	**1,117.30**

Source: "National Typology of School Buildings in Serbia" (eds. M. Jovanovic Popovic, D. Ignjatovic), Deutsche Gesellschaft für Internationale Zusammenarbeit, 2018

Table 5.1.2. Kindergarten building stock and heating energy consumption (current status)

Cluster	Number	Net floor area	Total required heating energy	Total required energy for sanitary water heating	Total delivered energy	Total primary energy
		[m²]	[GWh/a]	[GWh/a]	[GWh/a]	[GWh/a]
A1	236	38,704.00	10.44	0.39	14.45	14.99
A2	100	55,000.00	13.62	0.55	16.22	21.99
B1	184	49,680.00	15.46	0.50	18.53	28.23
B2a	128	76,800.00	16.44	0.77	20.95	25.43
B2b	117	140,400.00	30.14	1.40	38.41	46.60
C1	323	58,140.00	16.01	0.58	19.45	27.40
C2	897	1,089,855.00	212.96	10.90	273.36	298.96
C3	309	684,435.00	133.81	6.84	177.67	222.50
D2	187	187,000.00	15.37	1.87	20.33	22.46
D3	110	253,000.00	13.26	2.53	18.22	23.89
TOTAL	**2,591**	**2,633,014.00**	**477.51**	**26.33**	**617.59**	**732.44**

Source: "National Typology of Kindergartens in Serbia" (eds. M. Jovanovic Popovic, D. Ignjatovic), Deutsche Gesellschaft für Internationale Zusammenarbeit, 2018

The energy consumption figures presented in Tables 5.1.1 and 5.1.2, same as all other energy consumption data in this study, are calculated based on the Serbian Rulebook on Energy Efficiency in Buildings, which does not take into account the fact that schools and kindergartens are not being heated at night, during holidays, and over weekends, and that some schools operate in shifts, as well as that the entire floor area is not being heated. This is why the figures in the tables are higher than the actual energy consumption.
Total primary energy is lower than total delivered (final) energy due to the large share of fire wood as a fuel, as wood has quite low of conversion ratio of final into primary energy.

5.2. Renovation scenarios and dynamics

The macroeconomic impact of energy efficiency improvement programmes is determined by the scale and schedule of the retrofit programme. Four retrofit scenarios have been considered in this study, differing in terms of renovation rate and renovation scope. Two different renovation rates and two different renovation scopes will be considered. Different renovation rates and scopes imply differences in the time needed to complete the retrofits of buildings, but also in the investment volume and the resulting energy savings, directly affecting the overall macroeconomic effects of the programme.

Table 5.2.1 summarises the scenarios, differentiated by renovation rate. SLOW renovation scenario assumes the renovation rate of 2% of total floor area per year, while FAST renovation scenario assumes an annual renovation rate of 5%. The renovation speed has a direct impact on the anticipated completion period, varying from 20 years in the FAST scenario to 50 years in SLOW scenario.

Table 5.2.1. Retrofit rate scenarios regarding renovation speed

Scenario	Characteristics	Renovation rate	Duration for completion
SLOW Scenario	retrofit with slow implementation rate	2% of the total floor area per year	50 years
FAST Scenario	retrofit with fast implementation rate	5% of the total floor area per year	20 years

The slow renovation scenario assumes the renovation of approximately 147 thousand square meters of the total surface of the building per year in total, of which 95 thousand square meters in schools, and 53 thousand square meters in kindergartens.

In the fast renovation scenario, the assumed renovation rate is approximately 368 thousand square metres per year in total, of which 237 thousand square meters in schools, and 132 thousand square meters in kindergartens.

It is assumed in the study that renovation rate is the same for each building type.

Tables 5.2.2 summarizes the floor area that should be renovated on an annual basis.

Table 5.2.2. Annual floor area (m^2) renovation

	Schools	Kindergartens	Total
Slow scenario	94.702	52.660	**147.362**
Fast scenario	236.755	131.651	**368.405**

Source: Author’s calculation

The evolution of the total floor area renovated can be seen in Chart 5.2.1.

Chart 5.2.1. Renovation dynamics within different scenarios (cumulative square meters)

Source: Author's calculation

Regarding the scope of the retrofits, two different scenarios will be considered: Improvement 1, and Improvement 2. Within the IMPROVEMENT 1 scenario, energy efficiency measures refer only to thermal envelope of the building, without the changes in the heating type and fuel. IMPROVEMENT 2 scenario assumes deep retrofit of thermal envelope of the building, and use of wood biomass as a fuel, except in case when the school/kindergarten is connected to district heating, with the heating plant operating on natural gas as a fuel. In other words, IMPROVEMENT 2 scenario assumes the switch of the heating system and different fuel in most cases. The two scenarios differ in terms of savings potential, and in terms of the investment required.

A detailed description of the assumptions regarding the renovation with respect to thermal coating and thermosetting systems of the buildings are given in Appendix 1.

6. Potential savings and investments in energy efficiency improvements in Serbian schools and kindergartens

Investments in energy efficiency improvements in Serbian schools and kindergartens could lead to substantial energy and monetary savings. These savings and the investment volume needed for building retrofits are estimated in this section.

6.1. Potential energy savings

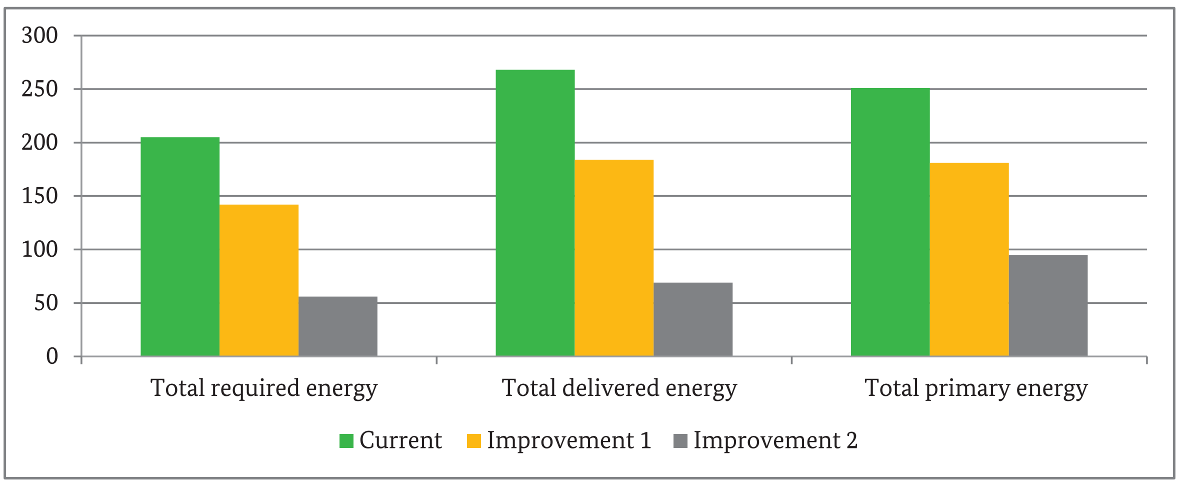
The energy for heating (including domestic hot water) which is currently required in Serbian schools and kindergartens is estimated at 205 kWh/sqm annually, while the energy which is actually delivered amounts to 268 kWh/sqm (Table 6.1.1). In case of IMPROVEMENT 1 scenario, the required energy would be 142 kWh/sqm annually, while delivered energy would be 184 kWh/sqm. In case of IMPROVEMENT 2 scenario, required energy would be at 56 kWh/sqm, and delivered energy would be at 69 kWh/sqm annually (Chart 6.1.1).

Table 6.1.1. Heating energy consumption per square meter of floor area before and after retrofits

Current			Improvement 1			Improvement 2		
Total required energy	Total delivered energy	Total primary energy	Total required energy	Total delivered energy	Total primary energy	Total required energy	Total delivered energy	Total primary energy
[kWh/m²,a]	[kWh/m²,a]	[kWh/m²,a]	[kWh/m²,a]	[kWh/m²,a]	[kWh/m²,a]	[kWh/m²,a]	[kWh/m²,a]	[kWh/m²,a]
205	268	251	142	184	181	56	69	95

Source: Author's calculation based on "National Typology of School Buildings in Serbia" and "National Typology of Kindergartens in Serbia" (eds. M. Jovanovic Popovic, D. Ignjatovic), Deutsche Gesellschaft für Internationale Zusammenarbeit, 2018

Chart 6.1.1 Heating energy consumption per square meter of the floor before and after retrofits (kWh/m²,a)



Source: Author's calculation

Undoubtedly, the realisation of the renovating scenarios will generate substantial energy savings. Table 6.1.2 shows the heating energy consumption (including domestic hot water) before and after renovation of schools and kindergartens, currently, same as in case of the IMPROVEMENT 1 and IMPROVEMENT 2 scenarios.

Table 6.1.2. Energy consumption for heating and hot sanitary water before and after retrofit of schools and kindergartens

			Kindergartens	Schools	Total
	Number of buildings		2.591	3.890	6.481
	Net floor area	[m²]	2.633.014	4.735.090	7.368.104
Current	Total required energy	[GWh/a]	503,84	1007,02	1510,86
	Total delivered energy	[GWh/a]	617,59	1357	1974,59
	Total primary energy	[GWh/a]	732,44	1117,3	1849,74
Improvement 1	Total required energy	[GWh/a]	356,68	691,54	1048,22
	Total delivered energy	[GWh/a]	436,06	921,37	1357,43
	Total primary energy	[GWh/a]	527,86	805,33	1333,19
Improvement 2	Total required energy	[GWh/a]	222,76	409,33	409,33
	Total delivered energy	[GWh/a]	276,55	507,62	507,62
	Total primary energy	[GWh/a]	242,97	456,12	699,09

Source: Author's calculation based on "National Typology of School Buildings in Serbia" and "National Typology of Kindergartens in Serbia" (eds. M. Jovanovic Popovic, D. Ignjatovic), Deutsche Gesellschaft für Internationale Zusammenarbeit, 2018

The total required energy for heating and domestic hot water in schools and kindergartens decreases from current 1,510 GWh per year to 1,048 GWh in case of the IMPROVEMENT 1 scenario, or to 409 GWh in case of the IMPROVEMENT 2 scenario.

At the same time, the total delivered energy for heating and domestic hot sanitary water could decrease from current 1,974 GWh annually to 1,357 GWh (IMPROVEMENT 1), or to 507 GWH annually (IMPROVEMENT 2).

The total primary energy used would drop from current 1,850 GWh annually to 1,333 GWh in case of the IMPROVEMENT 1 scenario, or to 699 GWh in case of the IMPROVEMENT 2 scenario.

Based on the previous data, Table 6.1.3 shows the potential energy savings after the retrofits of schools and kindergartens in Serbia.

Table 6.1.3. Energy savings after retrofits of schools and kindergartens

			Kindergartens	Schools	Total
	Number of buildings		2,591	3,890	6,481
	Net floor area	[m^2]	2,633,014	4,735,090	7,368,104
Improvement 1 savings	Total required energy	[GWh/a]	147.16	315.48	462.64
	Total delivered energy	[GWh/a]	181.53	435.63	617.16
	Total primary energy	[GWh/a]	204.58	311.97	516.55
Improvement 2 savings	Total required energy	[GWh/a]	281.08	597.69	1101.53
	Total delivered energy	[GWh/a]	341.04	849.38	1466.97
	Total primary energy	[GWh/a]	489.47	661.18	1150.65

Source: Author's calculation based on "National Typology of School Buildings in Serbia" and "National Typology of Kindergartens in Serbia" (eds. M. Jovanovic Popovic, D. Ignjatovic), Deutsche Gesellschaft für Internationale Zusammenarbeit, 2018

In case of the IMPROVEMENT 1 scenario, 463 GWh of required energy could be saved annually, 617 GWh of delivered energy, and 516 GWh of primary energy. In case of the IMPROVEMENT 2 scenario, 1,101 GWh of required energy could be saved annually, 1,467 GWh of delivered energy, and 1150 GWh of primary energy. Table 6.1.4 shows the energy savings after retrofits of schools and kindergartens.

Table 6.1.4. Energy savings (%) after retrofits of schools and kindergartens

Improvement 1 savings			Improvement 2 savings		
Total required energy	**Total delivered energy**	**Total primary energy**	**Total required energy**	**Total delivered energy**	**Total primary energy**
31%	31%	28%	73%	74%	62%

Source: Author's calculation

The previous figures represent the savings after the renovation of the entire building stock of schools and kindergartens in Serbia. Annual energy savings, however, depend on the renovation rate. In case of the SLOW retrofit scenario, 2% of the schools and kindergartens would be retrofitted annually, meaning that only 2% of calculated savings would be achieved in the first year. In case of the FAST renovation scenario, 5% of the calculated energy savings would be achieved per year. In other words, the annual energy savings depend on two factors: renovation rate and renovation scope.

Table 6.1.5 presents the additional annual energy savings (in terms of GWh of delivered energy).

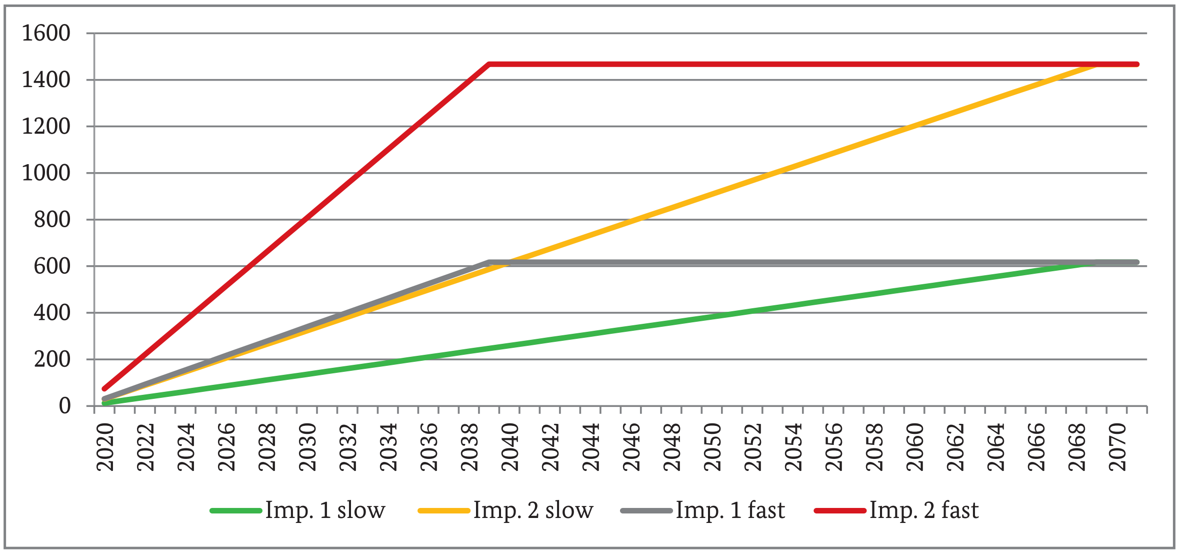
Table 6.1.5. Potential additional final energy savings in different scenarios (GWh annually)

	SLOW renovation	FAST renovation
Improvement 1	12.34	30.85
Improvement 2	29.33	73.34

Source: Author's calculation

The energy savings grow fast, as every year the savings from the buildings retrofitted in the current year are added to the savings from all previously renovated buildings. Chart 6.1.2 shows the energy savings dynamics through years.

Chart 6.1.2. Energy savings dynamics (GWh)



Source: Author's calculation

6.2. Savings in monetary terms

Potential savings in energy bills due to retrofits of schools are calculated using the "Calculator for the analysis of energy efficiency measures in school buildings" (project "Energy Efficiency in Public Buildings in Serbia", implemented by GIZ). The savings are estimated based on the heating costs in Serbia.

Table 6.2.1 shows the estimated savings by building types. Savings in case of the IMPROVEMENT 2 scenario are on average 1.9 times higher than savings in the IMPROVEMENT 1 scenario, due to the fact that the IMPROVEMENT 1 scenario is related only to retrofit of the building thermal envelope, while the IMPROVEMENT 2 scenario includes the fuel switch to wood biomass, except when the school uses district heating based on natural gas as a fuel.

Table 6.2.1. Annual savings, by building type (EUR per school)

	Improvement 1	Improvement 2
A1	1.794	2.175
A2	2.893	4.460
A3	17.950	43.675
B1	693	1.093
B2	7.810	14.729
B3	16.729	37.039
C1	1.137	1.611
C2	5.345	9.364
C3	5.404	5.896
D3	2.627	4.985

Source: Author's calculation based on the "Calculator for the analysis of energy efficiency measures in school buildings" (project "Energy Efficiency in Public Buildings in Serbia", implemented by GIZ)

The weighted averages of savings, per representative building and per square meter of the school floor are shown in Table 6.2.2. Average saving is 5 EUR/m^2 in case of the IMPROVEMENT 1 scenario, or 10 EUR/sqm in case of the IMPROVEMENT 2 scenario. These estimations will be used in this study for the entire building stock of schools and kindergartens in Serbia.

Table 6.2.2. Weighted average annual savings (EUR)

	Improvement 1	Improvement 2
per building type	6.049	11.927
per square meter	5	10

Source: Author's calculation

Total savings, in case of renovation of the entire building stock of schools and kindergartens in Serbia is estimated at EUR 36.6 million per year in case of the IMPROVEMENT 1 scenario, i.e. at EUR 72.2 million per year in case of the IMPROVEMENT 2 scenario. Total savings are shown in Table 6.2.3.

Table 6.2.3. Annual savings for total building stock (EUR)

	Improvement 1	Improvement 2
schools	23.529.361	46.397.179
kindergartens	13.083.835	25.799.810
total	**36.613.196€**	**72.196.990**

Source: Author's calculation

The presented savings refer to renovation of the total building stock of Serbian schools and kindergartens. The additional annual savings, however, depend on renovation speed. In case of SLOW renovation scenario (2% of the total floor area annually), annual savings would be EUR 0.73 million in case of the IMPROVEMENT 1, i.e. EUR 1.44 million in case of the IMPROVEMENT 2 scenario (Table 6.2.4). In case of FAST renovation scenario, annual savings would amount to EUR 1.83 million (IMPROVEMENT 1), i.e. EUR 3.61 million (IMPROVEMENT 2).

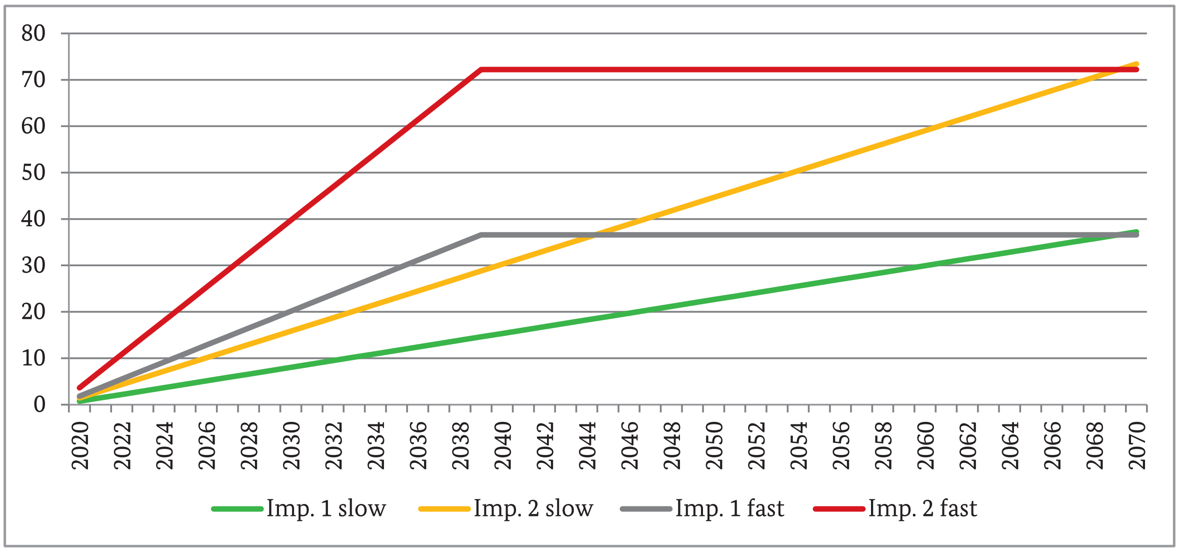
Table 6.2.4. Additional annual savings in different scenarios (million EUR)

	SLOW renovation	FAST renovation
Improvement 1	0.73	1.83
Improvement 2	1.44	3.61

Source: Author's calculation

Chart 6.2.1 shows the savings dynamics over years.

Chart 6.2.1. Savings dynamics (million EUR)



Source: Author's calculation

6.3. Investments

The investment volume needed for the energy-efficiency improvements in school and kindergarten buildings are estimated based on the "Calculator for the analysis of energy efficiency measures in school buildings" (project "Energy Efficiency in Public Buildings in Serbia", implemented by GIZ).

Table 6.3.1 shows the estimated total investment by building type. Total needed investment in case of the IMPROVEMENT 2 scenario is on average 2.4 times higher than investment in the IMPROVEMENT 1 scenario. IMPROVEMENT 1 scenario is related only to retrofit of thermal envelope of the building, while IMPROVEMENT 2 scenario includes the fuel switch to wood biomass, except when the school uses district heating based on natural gas as a fuel.

Table 6.3.1. Energy efficiency investments, by building type (EUR per school/kindergarten)

	Improvement 1	Improvement 2
A1	34,579	81,222
A2	53,000	160,847
A3	103,670	305,656
B1	15,413	52,135
B2	59,254	119,543
B3	142,876	334,002
C1	21,736	60,736
C2	133,831	187,050
C3	150,262	358,861
D3	360,311	444,400

Source: Author's calculation based on the "Calculator for the analysis of energy efficiency measures in school buildings" (GIZ Project "Energy Efficiency in Public Buildings in Serbia")

The weighted averages of investment, per representative building and per square meter of the school floor are shown in Table 6.3.2. Average investment needed for retrofit of schools is 65 euro/ m^2 in case of the IMPROVEMENT 1 scenario, i.e. 146 euro/m^2 in case of the IMPROVEMENT 2 scenario. These estimations will be used in this study for the entire building stock of schools and kindergartens in Serbia.

Table 6.3.2. Weighted average investment (EUR)

	Improvement 1	Improvement 2
per representative building	79.460	178.089
per square meter	65	146

Source: Author's calculation

Total investments required for the renovation of the entire building stock of schools and kindergartens in Serbia is estimated at EUR 480 million in case of the IMPROVEMENT 1 scenario, or at EUR 1,078 million in case of the IMPROVEMENT 2 scenario. Total investment needed is shown in Table 6.3.3.

Table 6.3.3 Investment needs for total building stock (EUR)

	Improvement 1	Improvement 2
schools	309.101.176	692.764.888
kindergartens	171.145.910	385.221.748
total	**480.247.086**	**1.077.986.636**

Source: Author's calculation

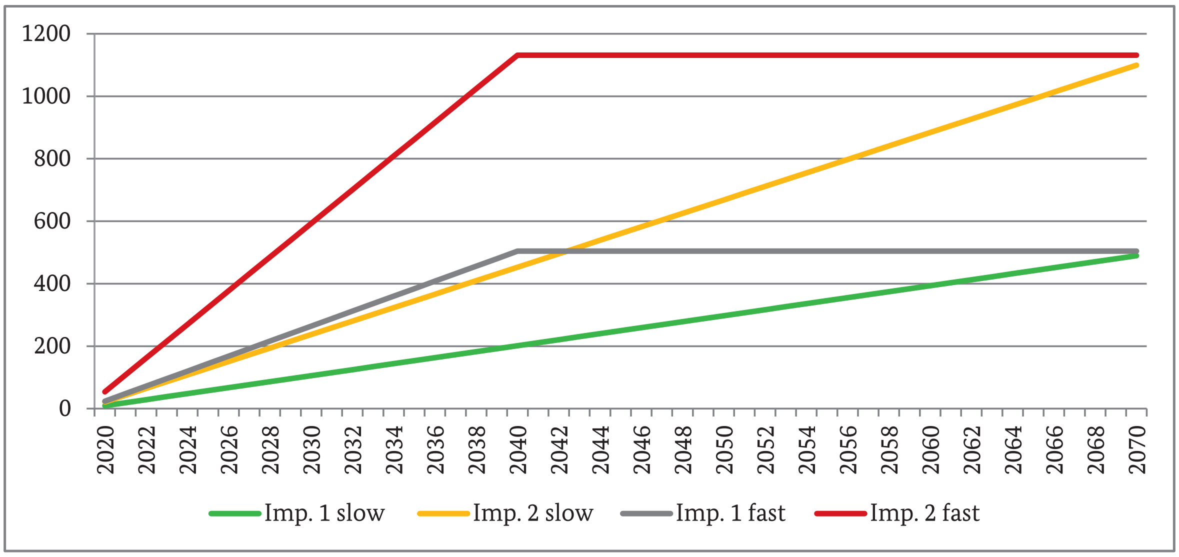
Presented investments refer to renovation of total building stock of Serbian schools and kindergartens. The annual investments, however, depend on renovation speed. In case of SLOW renovation scenario (2% of the total floor area annually), annual investment would be EUR 9.60 million in case of the IMPROVEMENT 1, i.e. EUR 21.56 million in case of the IMPROVEMENT 2 scenario (Table 6.3.4). In case of FAST renovation scenario, annual investment would amount to EUR 24.01 million (IMPROVEMENT 1), i.e. EUR 53.89 million (IMPROVEMENT 2).

Table 6.3.4. Annual investments in different scenarios (million EUR)

	SLOW renovation	FAST renovation
Improvement 1	9.60	24.01
Improvement 2	21.56	53.89

Source: Author's calculation

Chart 6.3.1. Investment dynamics (million EUR)



Source: Author's calculation

6.4. Investment pay back analysis

Based on the estimations of savings and investments, it is possible to conduct a simple investment pay-back analysis. It provides crucial information for designing the public financing programme supporting the energy efficiency improvements in buildings, by estimating the period over which the investment in retrofit would be paid back based on savings in energy bills.

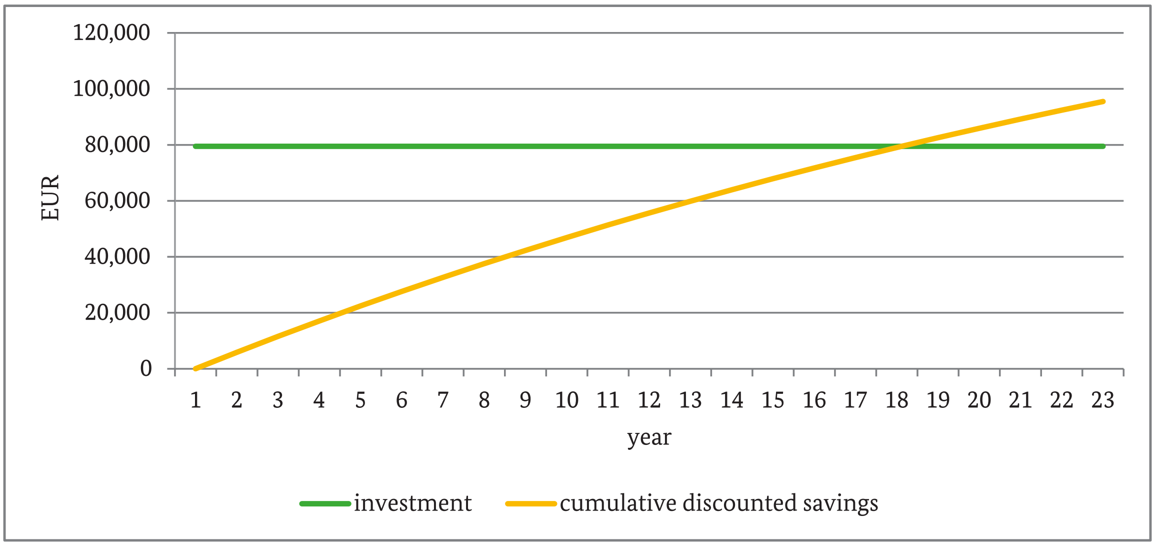
Energy efficiency investment pay back period is important from the perspective of estimating effect of public budget. Energy efficiency investments in schools and kindergartens in Serbia are usually done by using either national funds (budgetary EE fund and funds channelled by the Public Investment Management Office), donations or loans (WB, KfW) to the central government.

The investment volume for the representative building (weighted average of investments needed for the retrofit of clusters' representative buildings) is EUR 79,460 in case of the IMPROVEMENT 1 scenario, or EUR 178,089 in case of the IMPROVEMENT 2 scenario (Table 6.3.2).

The annual savings for the representative building (weighted average of savings of clusters' representative buildings) are at EUR 6,049 in case of the IMPROVEMENT 1 scenario, or at EUR 11,927 in case of the IMPROVEMENT 2 scenario (Table 6.2.2).

Bearing in mind that the purchasing power of a given amount of cash shrinks over time, and in the face of very long period of consideration, it is crucial to employ a discounted cash flow analysis. The results of the investment payback analysis are very sensitive to the introduction of a discount rate. In this study, a 3% discount rate is used, as it represents the targeted inflation of the National Bank of Serbia. Charts 6.4.1 and 6.4.2 present the results of investment pay back analysis based on discounted cash flows for two renovation scope scenarios.

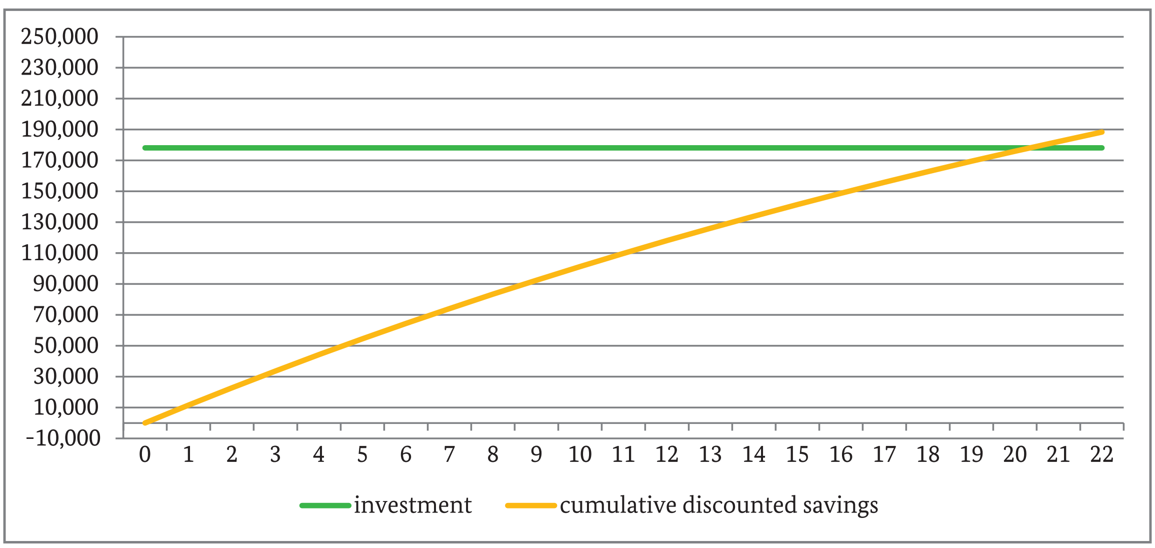
Chart 6.4.1. Investment pay back analysis for representative building, IMPROVEMENT 1 scenario



Source: Author's calculation

The analysis has shown that the investment in school and kindergarten energy efficiency improvements would be paid back in 18 years in IMPROVEMENT 1 scenario, and in21 years in the IMPROVEMENT 2 scenario.

Chart 6.4.2. Investment pay back analysis for representative building, IMPROVEMENT 2 scenario



Source: Authors' calculation

7. Macroeconomic effects of energy efficiency improvements in Serbian schools and kindergartens

7.1. Employment effect

The employment effect of public investments is one of the crucial determinants of the government decision whether to implement an energy efficiency programme. As explained in the methodology section, this study estimates the total employment effect (direct, indirect and induced) as a net job creation (taking into account the displacement effect in the energy sector) per million EUR invested in energy efficiency improvement in school and kindergarten buildings in Serbia.

It is assumed that – during the investment period – 26 direct jobs would be created in construction sector per EUR 1 million invested in retrofits. During the same period, Serbian energy sector is going to lose 5 jobs per million invested in energy efficiency improvements in a cumulative way, due to lower energy demand. On the other hand, additional municipal funds can be spent because of the savings on energy expenditure. These are also cumulative effects and compensate (totally, by assumption) the jobs lost in the energy sector. The net direct job creation during the investment period is, thus, 21 new jobs per EUR 1 million invested in energy efficiency improvements in schools and kindergartens. By assuming that job gains due to increased municipal spending because of savings in energy expenditures compensate the job losses in the energy sector, there will be no employment effect at all after the investment period. However, it could be argued that municipal spending on local issues like education or child care creates more jobs than municipal spending in the energy sector which is highly capital-intensive and depends on imports. That is, the overall employment effect after the investment period is most likely positive.

The job creation effect differs for different renovation scenarios, as it is the case with the required annual investment volume. The lowest effect is in case of the SLOW IMPROVEMENT 1 scenario (202 new direct jobs), while it is the highest in case of the FAST IMPROVEMENT 2 scenario (1,132 new direct jobs). Table 7.1.1 summarises the net direct job creation effect for different scenarios. As the SLOW and FAST scenarios refer to different time periods, in the SLOW scenario the job creation effect would last for a longer period of time (50 years), while the period is shorter for the FAST scenario (20 years).

Table 7.1.1. Net direct job creation (FTE) in different scenarios

	SLOW renovation	FAST renovation
Improvement 1	202	504
Improvement 2	453	1,132

Source: Author's calculation

In order to obtain the total employment effects generated by the energy efficient retrofit scenarios considered in this study, it is necessary to add the indirect and induced impacts to the direct impacts in the construction and energy sectors. Indirect employment effects are generated in other sectors than construction as a result of the increased demand for construction activities. Induced impacts come from the additional disposable income generated by new jobs.

Indirect and induced employment effects are estimated based on LM3 methodology of estimation of economic multipliers, developed by New Economic Foundation, and slightly modified for the purpose of this study. This approach is based on surveys which aim to describe the spending patterns of the companies and people. For the purpose of this study, the indirect effect is estimated based on Serbian construction companies' spending on services and products from other companies in the supply chain. Induced employment effect is estimated based on employees' spending patterns. A detailed description of the LM3-based methodology applied in this study is provided in Appendix 2.

Based on the multiplier from the LM3 model, the total net indirect and induced impact is estimated at 1.15 of the direct impact (see Appendix 2), meaning that indirect and induced benefits to national economy outweigh direct benefits in the construction sector. An initial EUR 1.00 spent by construction companies generates EUR 1.15 of additional indirect and induced revenues in domestic economy. This result applies for energy efficiency renovation of all types of the buildings, including both schools and kindergartens.

Table 7.1.2 presents the total net employment effect of energy efficiency improvements of schools and kindergartens in Serbia. Job creation effect ranges from 433 (SLOW IMPROVEMENT 1 scenario) to 2,433 new jobs (FAST IMPROVEMENT 2 scenario).

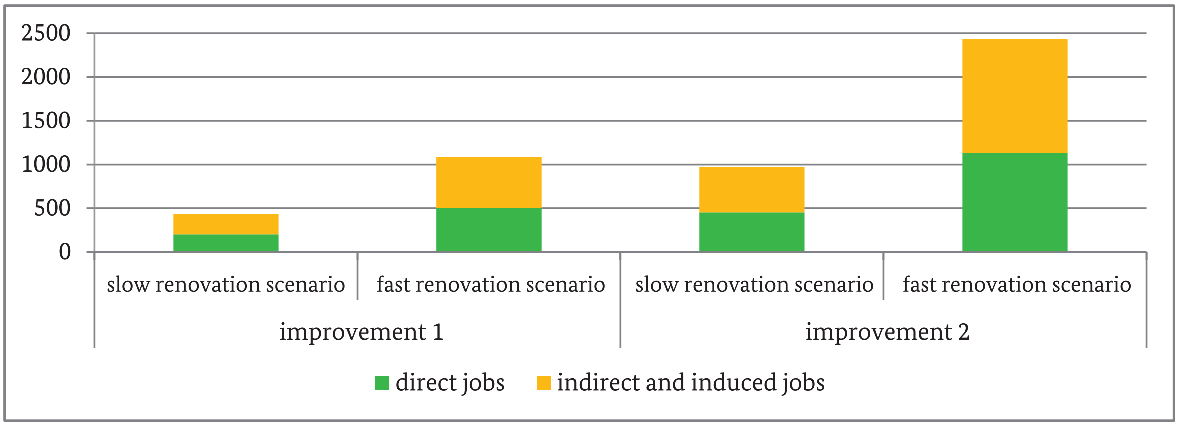
Table 7.1.2. Total net job creation (FTE) in different scenarios

	SLOW renovation	FAST renovation
Improvement 1	433	1,084
Improvement 2	973	2,433

Source: Author's calculation

Chart 7.1.1 shows the job creation effect in different scenarios.

Chart 7.1.1. Job creation effect in different scenarios (new FTE jobs)



Source: Author's calculation

7.2. GDP effect

The investments into energy efficiency related programmes would certainly lead to an increase in Serbian GDP. The GDP effect is evaluated on the basis of the employment effect, linked to the gross domestic product via labour productivity.

According to the data of the Statistical Office of the Republic of Serbia, average labour productivity (in terms of GDP per employee) was EUR 17,840 in 2017. Bearing in mind the sector distribution of gross value added and total number of employees, labour productivity in construction sector is estimated at EUR 18,610, which will be used for the estimation of the GDP effect in this study.

Table 7.2.1 displays the GDP effect of energy efficiency improvements in Serbian school and kindergarten building stock. The smallest effect is in case of SLOW IMPROVEMENT 1 scenario (EUR 8.06 million of additional GDP annually), while it is the biggest in case of FAST IMPROVEMENT 2 scenario (EUR 45.28 million of additional GDP annually). It should be noted that this is a one-off upwards shift of the GDP during the investment period.

Table 7.2.1. GDP effect (in million EUR) in different scenarios

	SLOW renovation	FAST renovation
Improvement 1	8.06	20.17
Improvement 2	18.11	45.28

Source: Author's calculation

If we compare the estimated annual GDP effect with the annual investment volume, it could be concluded that the public investment multiplier (defined as the ratio of the GDP increase and public investment volume) amounts to 0.84. Although our GDP estimation is in line with the employment factor approach and labour productivity, it seems rather low in the light of the existing literature. As literature review (Appendix 3) shows significantly higher multipliers (median value is 1.8), it could be argued that our GDP estimation is probably underestimated, and that it could be more than double if the multiplier of 1.8 was applied. For the sake of cautiousness, we provide the more conservative, lower results.

The estimated GDP increase would contribute to the growth of Serbian GDP with additional 0.02 percentage points in the SLOW IMPROVEMENT 1 scenario, i.e. with additional 0.12 percentage points in the FAST IMPROVEMENT 2 scenario (Table 7.2.2).

Table 7.2.2. Contribution to GDP growth rate (in percentage points)

	SLOW renovation	FAST renovation
Improvement 1	0.02	0.05
Improvement 2	0.05	0.12

Source: Author's calculation

Overall, the magnitude of the impacts is fairly small throughout. This partly reflects the scale of the inputs, and partly the conservative approach in the GDP estimation. However, there is also a clear trend that the impacts are positive, both for GDP and employment.

7.3. Public budget effect

Energy efficiency investments in schools and kindergartens in Serbia would have impacts on both budget revenues and budget expenditures. On the expenditure side, public investments in the field of energy efficiency improvements increase public spending (and budget expenditures), but, at the same time, energy efficiency improvements in schools and kindergartens would relieve public budgets from expenditures for energy (coal, oil etc). On the other hand, energy efficiency improvements in schools and kindergartens would boost economic activity, lead to higher GDP growth rates and create new jobs, which clearly lead to a rise in public budgets' revenues through increased revenues from sales and income taxes.

In this section, the potential of energy efficiency improvement in schools and kindergartens is examined from the perspective of public revenues:

- at local level, as municipal budgets will benefit from energy savings and local economic activity, and
- at national level, as the national budget will also benefit from the additional economic activity.

It should be noted, however, that local or national budgets may face the burden of financing the investments. It is assumed in this study that energy efficiency investments are debt-financed by the national government.

From the standpoint of local (municipal) government, straightforward positive impacts of energy efficiency improvements in schools and kindergartens are:

- lower expenditures on energy,
- increase in budget revenues due to higher income tax revenues, as new jobs and income are going to be created.

Estimated savings in the energy expenditures vary from EUR 0.73 to 3.61 million every year, depending on the renovation scenario (Table 6.2.4). These savings are cumulative over the investment period (50 years in the case of the SLOW renovation scenario, or 20 years in the case of FAST renovation scenario). After the renovation of the entire school and kindergarten building stock, annual savings on energy bills would be EUR 36.6 million in case of the IMPROVEMENT 1 scenario, or EUR 72.2 million in case of the IMPROVEMENT 2 scenario (Table 6.2.3).

Apart from saved expenditures on energy, municipal budgets would benefit from increased tax revenues related to the salary taxes on created jobs. According to the Serbian Law on Local Government Finance, 74% of taxes on wages and salaries are allocated to the municipal budget.

Table 7.3.1 shows the estimated sum of the increase of municipal budget revenues due to the job creation effect. Expected additional municipal budget revenues due to the increased employment and income as a result of energy efficiency improvements in Serbian schools and kindergartens vary from EUR 173 thousand in the SLOW IMPROVEMENT 1 scenario to EUR 973 thousand in the FAST IMPROVEMENT 2 scenario.

Table 7.3.1. Annual increase in local budget revenues in different scenarios (in EUR)

	SLOW renovation	FAST renovation
Improvement 1	173,376	433,621
Improvement 2	389,374	973,253

Source: Author's calculation. Average gross salary in Serbia in June 2018 was EUR 580. Average salary tax was EUR 45.

The assessment of the impact of improvements in energy efficiency in the schools and kindergartens on the national budget is quite more complex, however. Different types of revenues should be estimated:

- VAT directly related to the investments;
- Taxes on wages and salaries including social security contributions;
- All other government revenues (excises, taxes on income and wealth, taxes on goods and services excluding VAT, other taxes and non-tax revenues).

The standard VAT rate in Serbia is 20%. This rate is going to be applied in the estimations of the national budget effect of investment in energy efficiency improvements in schools and kindergartens. Table 7.3.2 shows the estimated impact of energy efficiency improvements in schools and kindergartens in Serbia on the national budget. These figures are based on the estimated VAT collection due to increased economic activity (increased GDP), and could be even higher in reality if other taxes and non-tax revenues in the national budget were taken into account.

Table 7.3.2. Annual increase in national budget revenues in different scenarios (in million EUR)

	SLOW renovation	FAST renovation
Improvement 1	1.61	4.03
Improvement 2	3.62	9.05

Source: Author's calculation

Estimated increase in national budget revenues varies from EUR 1.61 million (in the case of the SLOW IMPROVEMENT 1 scenario) to EUR 9.05 million (in the case of the FAST IMPROVEMENT 2 scenario).

8. Conclusions and recommendations

There is much more in the deep renovation of public buildings, such as schools and kindergartens, than "just" saving energy. A lot of benefits for the society would emerge, including the positive macroeconomic effects. Macroeconomic benefits comprise all effects of energy efficiency measures, which affect the economy of a municipality, region, and country. Three main macroeconomic impacts are economic development (measured by GDP), employment, and public budget impact.

Given the whole range of potential economic impacts of investments in improvement of energy efficiency in schools and kindergartens, the interest of policy makers for comprehensive cost-benefit studies is reasonable and expected. Governments should implement policies to address clearly identified needs and when the benefits of intervention outweigh the costs to society. Responsible policy makers should always consider both the costs and benefits of the measures to be implemented, and such an analysis should not be limited to financial aspects only, but should also address wider socio-economic aspects.

This study clearly shows that energy efficiency improvements in schools and kindergartens across the Republic of Serbia would lead to positive macroeconomic impacts: GDP growth, economic growth rate increase, new employment, increase in public budgets revenues, both at local and national levels. Investments in the school and kindergarten buildings retrofits could increase the GDP by EUR 45 million each year during the investment period, increase the economic growth rate by additional 0.12 percentage points, create up to 2,433 new jobs across the entire national economy, and increase the revenues in the public budgets by more than EUR 10 million.

Considering all these positive macroeconomic effects, the study has demonstrated that the government has the economic justification for providing financial incentives for energy efficiency improvement programmes in schools and kindergartens, as the increase in the budget revenues due to such programmes equals approximately 22% of total investment needed.

By providing wide support for energy efficiency improvement programmes, Serbian government could unlock the significant potential for creating additional jobs and boosting economic activity in the country.

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Data sources:

1. Serbian-German Development Cooperation Project, implemented by GIZ, "Energy Efficiency in Public Buildings in Serbia"

2. Statistical Office of the Republic of Serbia

Appendix 1: Description of the energy efficiency improvement measures

The principle of interventions on the thermal coating:

- Improvement 1 scenario, which is in accordance with applicable regulations, improves the energy class of the building by one level. Most often, this improvement is achieved by placing quality and well-built windows (coefficient of heat transfer U = 1.4 W/m^2k) that reduce the air flow (improvement of the class of tightness). In the case that the window change did not give the desired effects in improving the energy class, it should be intervened on other, easily accessible elements of the envelope, primarily on the insulation of the floor structure and the non-finished attic, and then on the insulation of the facade walls.
- Improvement 2 scenario, which represents an intervention in all elements of the building envelope in order to comply with the individual requirements of the thermal envelope of the buildings. The interventions mainly involve additional thermal insulation layers, but also a fundamental reconstruction with the replacement of all the worn components (reconstruction of flat and sloping roofs with the replacement of layers of waterproofing and roof coverings).

The principles of interventions on thermo-technical systems:

- In the Improvement 1 scenario, which includes small volume works on the building's envelope in order to reduce the required energy for heating, the existing heating system is retained except in cases when heating from local heating devices (furnaces) has switched to district heating or switching from liquid fuel to biomass.
- In the Improvement 2 scenario, all buildings switch to biomass (pellets in smaller buildings and wood chips in larger buildings), unless the objects are located in urban environment and are already connected to a district heating system with a heating plant that uses natural gas as the basic fuel which is the most environmentally friendly fossil fuel.

Appendix 2: Methodology to estimate the investment multiplier

In order to estimate the investment spending effects on a regional or national economy, several methods have been developed. Among these is the economic multiplier, based on input-output tables. However, input-output tables are unavailable in Serbia. Thus, we have decided to use an alternative approach. We rely on the Local Multiplier 3 (LM3) tool, which was developed by New Economic Foundation.

The LM3 model is based on the Keynes' multiplier insight, but uses a somewhat simpler approach based on surveys and is therefore easier to implement (The Urban Institute, 2009). The LM3 tool is a model for calculating the impacts on local communities. However, for calculating the impact of an industrial sector at national level, as is the case in this study (impact of the construction sector activities at national level), the LM3 tool needs to be adjusted.

The LM3 methodology is based on surveys of companies and their employees to assess their spending patterns. In the original LM3 model, spending is split in to two categories: local and non-from expenditures for energy (coal, oil etc) local. For the purpose of this study, spending is split in domestic spending (spending on domestic goods and services) and imports (spending on foreign goods and services). The more money is re-spent within the economy, the higher the multiplier effect is because additional domestic income is generated.

In a closed economy, the multiplier is very straightforward – income is being spent and re-spent thus resulting in a final increase representing multiplied value of the initial change. At each round of spending, some income is withdrawn from the circular flow in the form of savings by individuals and taxes by government. In the case of an open economy there is a leakage of money because of the imports. Imports consist of final goods and services as well as the intermediate input to which value is subsequently added within the economy. The openness of an economy is the degree to which it is subject to income leakages due to payments to agents outside the country (The Urban Institute, 2009).

Two different questionnaires were designed to capture the two general directions of expenditure: employees' expenditure and businesses expenditure of the Serbian construction companies and their major domestic suppliers. Business expenditures correspond to the indirect effect, i.e. effect upstream the supply chain. Employee expenditures, on the other hand, correspond to induced effect. The survey was conducted in 2017.

Ten companies from the construction sector (involved in energy efficiency related business) were included in the sample (so called original companies). The first step was to establish the structure of companies spending. The management of the company was asked to estimate what proportion of spending goes to domestic suppliers, and what proportion to foreign suppliers. As far as wages are concerned, it is assumed that the total wage bill went to employees that are living in Serbia.

Respondents were also asked to name several of their large suppliers and this list was used to construct a list of companies that were interviewed in the next round. The goal was to cover suppliers that accounted for more than 70% of domestic inputs to original companies. The management of these companies were interviewed in order to establish their company's spending patterns, i.e. the portions of domestic purchases and imports.

A second pillar of the methodology is to determine the spending patterns of the workers. The employees were interviewed using a different questionnaire, but with the same goal: to get a breakdown of spending patterns and to establish what part of spending was done domestically. Five employees per company were interviewed, i.e. 50 workers in total.

The following results were obtained from questionnaires:

Round 1	Portion of total spending
Spending of construction companies on domestic employees	0.20
Spending of construction companies on domestic suppliers	0.55
Round 2	
Domestic spending by employees of construction companies	0.75
Domestic spending by suppliers of construction companies	0.45

Based on collected data, the multiplier is calculated as follows:

$M = 1.00 + 0.2 + 0.55 + 0.2*0.75 + 0.55*0.45 = 2.15$

Based on the estimated multiplier, it can concluded that indirect and induced benefits to national economy outweigh direct benefits in construction sector (multiplier value is higher than 2). An initial 1.00 dinar spent by construction companies generates 1.15 dinars of additional indirect and induced revenues in domestic economy.

Appendix 3: Macroeconomic effects of energy efficiency improvements in buildings – literature review

The studies examining the macroeconomic effects of improved energy efficiency (where energy demand is reduced by 8 to 15%) suggest significant potential impacts including increases in GDP ranging from 0.8% to 1.26% (Holmes, I. and R. Mohanty, 2012). According to the IAE study "Capturing the Multiple Benefits of Energy Efficiency" (Campbell, N., Ryan, L., Rozite, V. and E. Lees, 2014) GDP growth rates range from 0.25% to 1.1%. Cambridge Econometrics (2015) undertook a quantitative analysis to determine the impact of energy efficiency on GDP in the UK. Their findings suggest that the UK's energy efficiency policies between 2000 and 2010 produced additional real annual GDP growth of 0.1%. Copenhagen Economics modelled the macroeconomic impacts of energy efficiency renovation of buildings in EU. They estimated that the GDP increase ranges from 2.35 to 3.03 billion EUR per Mtoe reduction in final energy demand (Copenhagen Economics, 2012).

Overview of the existing literature dealing with the GDP effect of the investment in energy efficiency improvements in buildings shows that the range of change in GDP per unit investment is $0.91-3.73 per $1 invested, while median is $1.81 (Ryan, 2015).

In summary, the case for energy efficiency from an economic growth perspective is good. Although the effects are estimated to be relatively small, they remain positive regardless the methods and assumptions used for estimation.

There have been numerous studies that have identified effects on employment of energy efficiency improvement. In the majority of studies, the net employment effects of energy efficiency are positive, irrespective of the modelling approach used. Most studies find that investment in energy efficiency has a small net positive effect on employment. This reflects the tendency for those sectors providing energy efficient goods and services (especially the buildings and construction sector) to be more labour-intensive than energy-producing sectors, particularly in energy importing countries (Quirion, 2013). However, the scale of reported employment impacts varies considerably, according to the intensity of the measures. In our review special attention is given to studies which analyse the effects of energy efficiency improvements in buildings.

Ürge-Vorstatz et al. (2012) estimate that a programme of deep building renovations in Poland saving between 0.6 and 1.3 billion EUR of energy expenditures annually would have a direct employment effect in the construction sector of between 15,000 and 87,000 full-time equivalent (FTE) jobs in 2020.

Pikas et al. (2015) estimate the employment impacts related to renovating apartment buildings in Estonia. The study finds that 17 direct and indirect jobs were created for every million EUR of investment. Directly, ten jobs were created in on-site construction activities, and between one and six were related to consultancy and manufacturing industries, respectively.

A certain degree of consensus can be seen forming around an estimated net impact of about 17 to 19 jobs created for every million EUR spent on energy efficiency interventions (Campbell, N., Ryan, L., Rozite, V. and E. Lees, 2014).

Research shows that energy efficiency programmes (such as financial incentives for energy efficient buildings) are delivering net benefits to public budgets. Kuckshinrichs, Kronenberg and Hansen (2013) estimate that the KfW support programme for energy efficient refurbishments and new constructions cost USD 1.3 billion in grants and in reduced interest charged for loans. The same programme promoted gross investment in energy efficiency of USD 25 billion in 2011 and is estimated to have induced gross investment of a further USD 12 billion in energy efficiency in buildings, which generated tax revenues from sales incurred by investors and on products of USD 7.7 billion. Thus, budget revenues increase in total for 5.9 USD for every USD 1 invested though program.

Copenhagen Economics (2012) estimates that an annual investment volume of USD 56 billion in the energy efficient renovation of buildings through 2020 in the EU would lead to a net enduring annual improvement in public budgets of between USD 41 billion and USD 56 billion. In other words, budget revenues will increase by 0.73 to USD 1 for every USD 1 publicly invested in the programme.