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# Economic impact of new energy performance standards for buildings

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## About the German Economic Team Georgia

The German Economic Team Georgia (GET Georgia) advises the Georgian government and other Georgian state authorities such as the National Bank on a wide range of economic policy issues. Our analytical work is presented and discussed during regular meetings with high-level decision makers. GET Georgia is financed by the German Federal Ministry for Economic Affairs and Energy. Our publications are publicly available at our website (www.get-georgia.de).

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**Economic impact of stricter energy performance standards for buildings**


**Executive Summary**

The Energy Performance of Buildings Directive 2010/31/EU (EPBD) and the Energy Efficiency Directive 2012/27/EU (EED) will require a significant adjustment of Georgia's energy efficiency policies with a profound effect on the building sector. Among the numerous measures which both directives contain, the requirement to set new legal minimum energy efficiency standards for newly constructed buildings and also buildings undergoing major refurbishment is the single measure with the largest economic impact.

The current standard for thermal transmittance ("heat losses") for the building envelope of around 1.7 $W/m^2K$ is less strict compared to other European countries with similar climatic conditions. While the EPBD does not prescribe a certain level for standards, the current level is unlikely to meet the criteria of being at a "cost-effective" level. This suggests that the implementation of the EPBD will see stricter minimum energy efficiency standards introduced.

We estimated the economic impact for three hypothetical minimum efficiency levels in order to assess the impact of stricter standards in case of new construction as well as for buildings undergoing major refurbishments. The results suggest that a lowering of the legal standard to about 1 $W/m^2K$ would only cause a moderate construction cost increase of between 2% (for multi-family homes) and 4% (single-family homes). However, with 8% return on investment due to the energy cost savings, the economic case of stricter standards is acceptable but not yet that convincing. The economic case is much better for stricter standards in case of major renovations with the return on investments due to energy cost savings reaching 14%.

The results suggest that stricter minimum energy efficiency standards for building are economically viable. To reduce the adjustment costs and increase the economic benefits, a phased introduction of the new minimum standards could be beneficial. Such a phased approach would see an early introduction of the new minimum requirements for large buildings (such as multi-family homes) and public buildings. Here the economic case is already good and many developers already voluntarily build according to higher standards. Such a phased approach has the benefit of providing valuable experience to both the construction sector and the public administration prior to the full roll-out. Additionally it may lead to a decline of the cost of materials and labour ensuring that the new minimum standards can be successfully extended to smaller buildings in 2019.



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### 1.1 Background and objective

The Association Agreement stipulates that Georgia becomes a member of the Energy Community (EC) and subsequently implements a number of EU directives that relate to the Community's competences.

Among a wide range of energy policy areas, the directives oblige Georgia to approximate its legislation in the field of energy efficiency to EU standards. In this context, the Energy Performance of Buildings Directive 2010/31/EU (EPBD) and the Energy Efficiency Directive 2012/27/EU (EED) are the two main documents to be implemented. The implementation schedule for Georgia will be the same as for the other EC members, with a corresponding time lag taking into account the number of years that Georgia signed later plus an additional lag of 12 months.

Georgia signed the Energy Community Treaty in October 2016. The accession protocol was ratified by Parliament in April 2017. The Protocol of Accession foresees the implementation of the EED by 31 December 2018. The EPBD has to be implemented by 30 June 2019.

Implementing the two directives into national law is a major undertaking with a potentially large impact on the building sector and the wider economy. In order to allow for an informed policy decision this paper aims to:

- Identify those requirements of the EPB Directive (2010/31/EU) and the EE Directive (2012/27/EU) which are likely to have the largest impact on the building sector (chapter 1)
- Assess the economic impact of the EPB Directive (2010/31/EU) and the EE Directive (2012/27/EU) on the building sector, especially the following questions (chapter 2):
    - What will be the impact on construction costs?
    - What are the resulting energy cost savings?
    - Will implementation of the new directives be economically viable?
- Identify implications for policy makers connected to energy efficiency policies (chapter 3).

The following sections provide an overview of Georgia's commitments as stipulated by the two directives and provide a first short assessment of the expected impact.

### 1.2 Energy Performance of Buildings Directive

Table 1 list the main provisions of the Energy Performance of Buildings Directive (2012/31/EU) and a short assessment of the likely impact.

**Table 1: Overview main provision of EPBD**

| **Energy Performance of Buildings Directive (2010/31)** | |
|---|---|
| **Provision** | **Effect / Assessment** |
| Develop a **methodology for calculating the energy performance of buildings** | One-off task in order to create a regulatory environment, methodology to be set up with international technical assistance |
| Setting **minimum energy performance requirements** for the building envelope at cost-optimal levels<br>• **Option to differentiate by building type and between new and existing buildings**<br>• **Revision at least every 5 years** | Necessary precondition for the creation of a regulatory environment, profound expert knowledge needed in the beginning, as requirements have to be created from scratch.<br>While international technical assistance might be helpful for the first time, future revisions may be done by local energy auditors. |
| Calculation of **cost-optimal levels of minimum energy performance requirements**<br>• **Differentiation by building type and between new and existing buildings**<br>• **Take into account climate, accessibility of energy infrastructure and other factors**<br>• **To be updated every 5 years** | Necessary precondition for the creation of a regulatory environment, profound expert knowledge needed in the beginning, as requirements have to be created from scratch.<br>While international technical assistance might be helpful for the first time, future revisions may be done by local energy auditors. |
| Apply new energy requirements to **new buildings**<br>• **Obligation to check feasibility of high-efficiency alternative systems before every new construction** | Provision with large economic impact<br>• Increased building costs for new construction<br>• Energy cost savings due to improved thermal features |
| Upgrade energy performance of **existing buildings**<br>• **In case of major renovation (>25% of surface renovated or renovation costs >25% of building's value) such that they will meet** | Provision with large economic impact<br>• Substantial additional costs for retrofitting to meet legal requirements<br>• Energy cost savings due to improved thermal features |

| | |
|---|---|
| **minimum energy performance requirements** | |
| **Technical building systems**<br>➢ **heating**<br>➢ **ventilation**<br>➢ **hot water**<br>➢ **air conditioning**<br>• **set requirements for such systems if replaced or newly installed in existing buildings**<br>• **option to apply these requirements also to new buildings**<br>• **support introduction of intelligent metering systems for new buildings or in case of major renovation**<br>• **option to install active control systems such as automation, control and monitoring systems** | Provision with large economic impact<br>• Substantial additional costs for equipment upgrade to meet legal requirements<br>• Energy cost savings due to improved efficiency of building systems and in turn reduced energy consumption |
| **Nearly Zero-Energy Buildings (nZEB):**<br>• **Buildings that consume zero or very little energy, coming 'to a very large extent' from renewable sources**<br>• **Develop a national plan for increasing the number of nZEB (new and existing buildings, targets differentiated according to building category)** | Large increase in building costs, partly offset by energy savings<br>However, likely to apply only for a limited share of new construction in the foreseeable future |
| Introduction of **energy performance certificates**<br>• leading role of public and frequently visited buildings | Costs for capacity building, may initially be supported by international technical assistance; in future, energy auditing will develop as a self-financing market |
| Introduction of **regular maintenance and inspection** of heating and air- conditioning systems | Costs for capacity building, may initially be supported by international technical assistance; in future, energy auditing will develop as a self-financing market |
| Introduction of **independent control systems** for energy performance certificates and inspection reports | 2 Options:<br>• Governmental institution: Financing of few |

| | |
|---|---|
| | staff members needed<br>• Private independent expert organisation: financing provided by auditing market |
| Make a **list of financial instruments / measures** that help to increase EP of buildings (especially existing ones) | • Setting up a national mechanism (fund) to coordinate financing<br>• Develop programmes to incentivise private sector financing |
| **Capacity building** (education of engineers, buildings experts) | |

The provisions of the EPBD can be divided into three fields:

The first package of them aims at creating a regulatory framework for energy efficiency in the buildings sector. Developing a methodology to calculate the energy performance of buildings and setting energy performance requirements at a cost optimal level are tasks on the legislative level. The main burden of this provision lies on the public sector. Georgia may draw on international technical assistance to accomplish these tasks.

The second package of provisions relates mainly to implementation of the new regulations. As this task requires large up-front investment by the public and private sectors, it is of great importance to get an understanding of the savings that can be achieved and whether the additional investment costs will pay off. Importantly, the directive does not stipulate a specific energy performance level but leaves it to the member state to define the cost effective level. The setting for a cost-effective level of the relevant energy performance standards is to follow a clear methodology.

Energy performance of buildings typically includes the thermal features of the building envelope as well as the efficiency of the technical building systems. In chapter 2 we carry out an assessment of cost-efficiency of improvements of the building envelope as these tend to be the measures which account for the highest share of additional construction or retrofitting costs.

The third package of provisions aims at developing market institutions serving monitoring purposes in the implementation process. In order to develop a certification, inspection and controlling system, mainly capacity building will be needed. Also, the coordination of financing will be an important issue.

## 1.3 Energy Efficiency Directive

**Energy Efficiency Directive (2012/27/EU)**

| Provision | Effect / Assessment |
| --- | --- |
| **National strategy** for renovation of buildings stock<br>• Setting up building inventory<br>• Develop cost-effective renovation concepts<br>• Strategy for incentivising investment<br>• Estimation of expected energy savings | This task has been already partly accomplished by developing a NEEAP, priorisation might be necessary. International technical assistance is provided. |
| **Renovating 1% of the public building stock** each year starting from 2018 considering the exemplary role of public buildings<br>• Relates to buildings used by Central Government that have minimum area of 500 $m^2$ (reduced to 250 $m^2$ after 1 ½ years)<br>• Buildings have to meet at least new minimum standards after renovation<br>• Option to renovate buildings owned by administrative authorities below central government level<br>• Preferential renovation of buildings with worst energy performance | Provision with large economic impact<br>• Substantial investment cost to meet carry out retrofitting and meet renovation targets<br>• Energy cost savings due to improved thermal features of public sector buildings<br>• Need for debt and liquidity management to finance upfront cost until payback through energy cost savings |
| Central government should **purchase only highly energy-efficient products, services and buildings** (above certain threshold value) | Increased purchase prices, (partly) set off by energy savings. |
| Introduction of **energy meters at competitive prices** for all end users<br>• To be installed when exchanged or when newly installed<br>• Billing of energy only based on real consumption (no lump sum) | Initial financing programmes might be necessary, later in a self-financing market for energy meters will develop. |
| **"Informed and competent user" campaign**<br>• Policy instruments incentivising more efficient energy use<br>• Information about efficient energy use | |

The scope of the Energy Efficiency Directive covers other topics besides the building sector. However, in the table above we summarized only those provisions that directly relate to the topic of this paper. The provision to renovate at least 1% of the public building stock annually is the one with the largest impact for the building sector, as it prescribes the speed with which implementation is to proceed.

### 1.4 Conclusions so far

Among the many provision of the two directives, the main impact will arise from the obligation to set stricter legal minimum energy performance requirements for newly constructed buildings and buildings undergoing major renovations. In addition, there is the obligation to achieve a 1% renovation target for public sector buildings which –after the retrofitting - will also have to fulfil the stricter minimum energy efficiency requirements.

Thus, in the following impact assessment we will focus on the likely impact from stricter minimum energy performance requirements. We will conduct a cost-benefit analysis of various levels of minimum standards in order to provide a general idea, which level of energy efficiency will pay-off from an economic perspective and will therefore be beneficial for the public sector but also for the private sector.

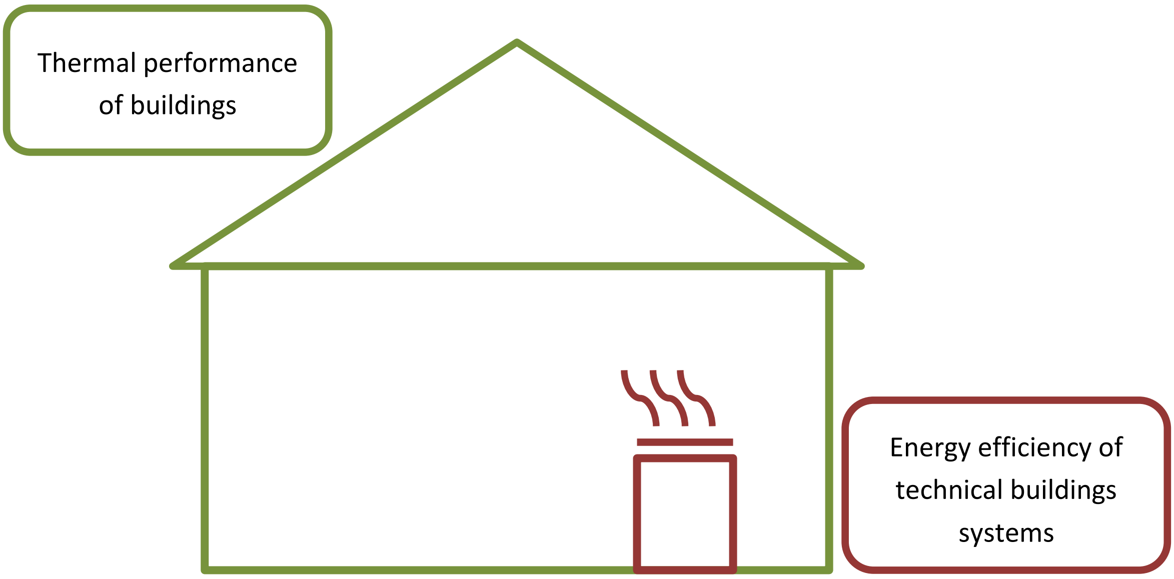
## 2. Energy performance in buildings – key indicators

The energy performance of buildings is usually regulated through two types of standards: standards regulating the thermal performance of buildings and standards regulating the efficiency of technical systems in the building.

Thermal performance of buildings standards usually specify a maximum heat loss for different building materials used in the building envelope. Typically the heat loss is expressed using the thermal transmittance value or u-value. The better insulated a structure, the lower the heat transmittance value or u-value. Usually, regulations concerning the thermal performance of buildings specify different u-values for the various parts of the building envelope such as walls, windows, doors and the floor. Some countries also use the reciprocal thermal resistance or r-value to describe the thermal resistance of a building structure. Correspondingly, a high r-value means that little energy is lost through the building envelope.

Another group of standards usually describe the efficiency of technical buildings systems. They are express the ratio of heating output over primary energy input and reflect, how efficiently technical systems and their parts (e.g. boilers, tubes, ventilation,…) generate and distribute energy.

**Figure 1 Key indicators of energy performance in buildings**




This paper focusses on the impact of new standards regulating the thermal performance of buildings – that is, stricter requirements regarding heat losses through the building envelope. In contrast, we do not consider the impact of higher efficiency standards for technical buildings systems (e.g. boilers). This is based on the assumption that the technical systems currently fitted into new buildings in Georgia – especially in urban areas – already have a comparatively high level of energy efficiency (e.g. energy efficiency of gas boilers amount to approx. 85-90%). Therefore, the impact of higher standards for technical building systems can be expected to be rather small.

## 3. Existing standards and energy performance of buildings

The impact from adjusting energy efficiency legislation to comply with the two EU directives depends on the current level of energy performance standards in buildings. Here it is necessary to distinguish between de-jure requirements and de-facto standards that are observed by the building sector. Depending on how challenging current standards are and how effective enforcement is, there may be a significant discrepancy between de-jure and de-facto standards.

### 3.1 Existing legal energy performance standards for buildings

A large share of the existing building regulations has its origin in Soviet times. Other regulations, which have been introduced later, have been directly copied from other countries. This leads to a situation in which several technical building standards regulating energy performance of buildings seem to exist in parallel.

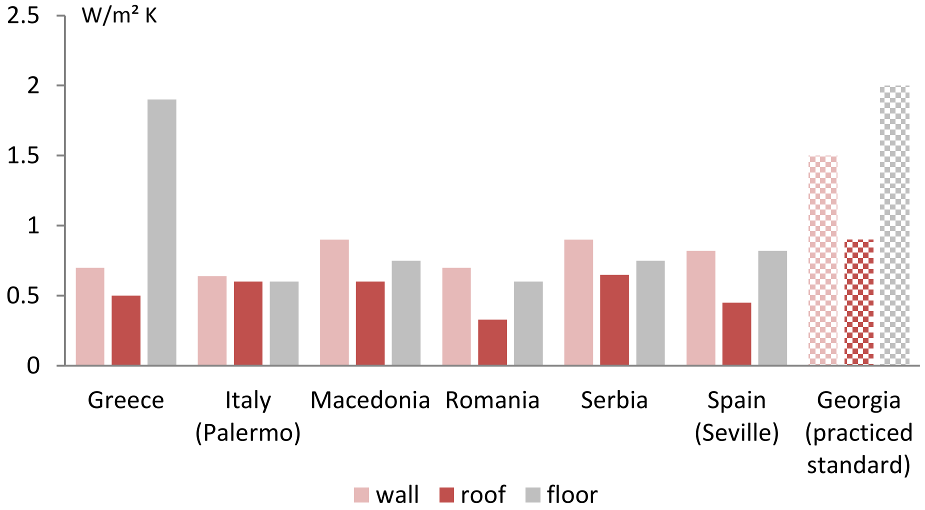
Unlike some of the fire resistance and safety standards which are of obligatory nature, the existing legal standards for the energy performance of buildings seem to have a rather informative character. In the case of international financing some building companies apply technical standards of the donor organisation. The effectiveness of the existing legal standards is weakened due to the absence of a strict monitoring process and a lack of auditing companies.

Among the various standards, the old Soviet thermal resistance coefficient of R=0.575 $m^2K/W$ (equal to a thermal transmittance value of 1.7 $W/m^2K$) is still in place and seems to be the main legal requirement regarding energy efficiency of buildings. The value sets the maximum thermal transmittance for the entire building envelope.

How do Georgian standards compare with other countries? Figure 1 below shows examples of the current legal minimum standards for main building elements in place in selected Southern European countries with similar climatic conditions as Georgia.

For the sake of comparison the current practiced standards (the average standards which seem to be observed by building companies, not the legal requirement) is also displayed in the chart. It suggests that the energy performance standards of new building in Georgia are lower than in other countries with similar climatic conditions. This indicates that there is room for applying stricter energy performance standards in Georgia.

**Figure 1: International comparison of legal minimum energy efficiency standards**




*Source: Ecofys, M2 Energy Audit Report*

Currently, a draft version of the new building code is being discussed in parliament. The new code is supposed to come into force by 1 July 2019. One year after the new building code coming into force, technical regulations will be adopted by government decree.

## 3.2 Current practiced energy performance standards of new buildings

With the current legal energy efficiency standards for the building envelope rather generous compared to other countries and also for several reasons not that binding, this raises the question which level of energy performance do new buildings achieve in reality.

Table 2 below shows an expert estimate of average thermal transmittance values for the main building envelope elements for a multi-storey apartment which are currently achieved by newly constructed buildings.

While these numbers represent only a rough estimate, it suggests that the typical thermal transmittance value for the building envelope of newly constructed multi-family buildings lies around 1.7 W/m$^2$K. If this is representative for all construction activity, practiced standards seem to be in line with the energy performance requirement stipulated in the old Soviet building code[1].

[1] The current building code still forsees the same r-value of 0.575 m$^2$K/W equalling an u-value of 1.7 W/m$^2$Kas the Soviet Code did.

**Table 2: Thermal transmittance values of building envelope - current practice**

| Building envelope elements | Thermal transmittance (u-value, $W/m^2K$) |
|---|---|
| **Floor** | 2.0 |
| **External walls** | 1.5 |
| **Roof** | 0.9 |
| **Windows** | 3.3 |
| **Thermal transmittance multi-family home (MFH)** | 1.7 |

*Source: M2 Energy Audit Report*

At the same time a number of new developments currently projected and constructed achieve thermal transmittance values of around 1.0 $W/m^2K$ thus significantly below the current legal threshold. With some developers already voluntarily offering buildings with higher energy performance than the legal obligation, there is indication that stricter energy performance standards in buildings are economically viable.

There is no information available of the practiced energy efficiency standards for the building envelope of newly constructed single-family buildings. However, it is fair to assume that the values will be similar or slightly higher than those for multi-family homes.

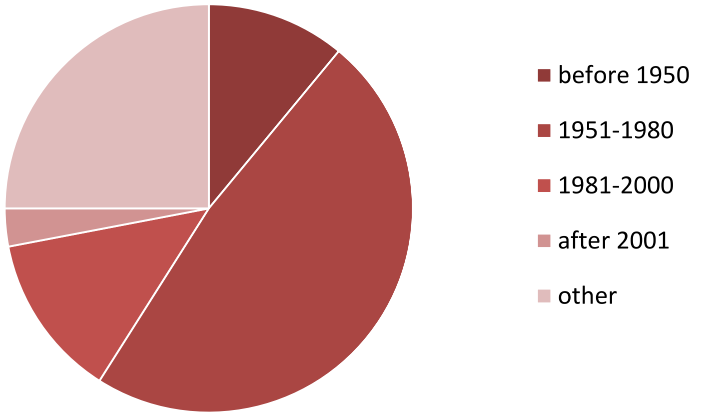
## 3.3 Energy performance of the existing building stock

The EPB directive requires national governments to set minimum energy efficiency standards for existing buildings in case they undergo major renovations. Additionally, the Energy Efficiency Directive stipulates that a certain share of public sector buildings has to be renovated per year to meet higher energy efficiency standards.

In order to understand the impact of these provisions, it is necessary to know what the energy performance of the existing building stock is.

It can be expected that the energy performance of existing buildings varies significantly depending on the building type, construction period and location in the different climatic zones within Georgia. Buildings constructed after 2001 can be expected to achieve higher energy efficiency standards, however only 3% of the existing building stock fall into that construction period. The largest share of of the existing building stock (almost 50%) dates from Soviet Union period – including the typical Khrushchevka pre-fab buildings – which can be expected to feature a low thermal resistance.

**Figure 2: Building stock by construction period**




*Source: USAID*

To our knowledge there is no representative public data about the energy performance of the building stock available. For purpose of analysis we make assumptions, based on data from energy audits, expert views and comparison with other countries with similar climatic conditions.

The assumptions regarding the thermal transmittance values of the existing building stock are displayed in Table 3 below. Total thermal transmittance for the entire building envelope is expected to lie around 3 $W/m^2K$ for apartment buildings and slightly higher for single family homes.

The rather high transmittance values (and in turn low thermal resistance) reflect that the building envelope of existing buildings typically does not contain any insulating materials. Windows in existing buildings will be predominantly single glazed without insulation.

**Table 3: Estimated thermal transmittance of existing building stock**

| Element of building envelope | Thermal transmittance $W/m^2K$ |
|---|---|
| **Floor** | 3.4 |
| **External walls** | 2.6 |
| **Roof** | 3.4 |
| **Window** | 5.5 |

*Source: Literature review and expert assessments*

The high thermal transmittance and with it rather poor insulation properties of the existing building stock has two implications in case of a major renovation: Additional retrofitting measures will be required in order to reduce thermal transmittance to levels compliant with stricter legal limits. On the other hand, the energy savings achievable even with simple retrofitting procedures are comparatively high.

## 4. Economic viability of stricter energy performance requirements for buildings

### 4.1 Description of different energy performance scenarios

To comply with the EPB directive, the government is obliged to set new standards regulating the energy performance of newly constructed buildings and also for buildings undergoing major renovation. In this section we present the financial impact of a tightening of energy performance standards through stricter requirements regarding the thermal performance of the building envelope. In short, the financial impact of the new standards depends on how the additional construction cost compare to the energy cost savings that result from reducing heat losses through the building envelope.

There are three factors that influence the economic viability of new energy efficiency standards:

Heating demand: usually expressed as Heating Degree Days (HDD) indicate the demand of heat that is necessary to heat a building to comfort level given a certain base temperature. Heating demand depends on the climatic zone in which the building is located: In colder zones, the amount of HDD's is higher and in milder zones it is lower. For the assessment we assume a location with 1600 HDD - similar to Tbilisi region characterized by hot summers and relatively mild winters. In our analysis we do not account for the phenomenon of "underheating", that is, not all rooms of a building are heated to comfort level. Underheating is quite widespread in Georgia and affects especially rural regions but also many public buildings like kindergartens and schools. If buildings are underheated, the number of HDD's will be lower. With heating demand lower, the actual heating cost savings that can be achieved through higher thermal buildings standards are also lower. While in case of underheating the financial savings will be lower, there will be positive welfare effects as people may decide to spend the energy cost savings in order to fully heat the entire flat as opposed to only single rooms.

The second important factor influencing the profitability of investments in energy efficiency is the current level of energy performance. As we described in section 3, the starting point is especially low for existing buildings.

Thirdly, construction costs due to increased standard play an important role for the assessment. In our assessment we use construction cost assumption for Southern Europe made by Ecofys (2007) which we reduced by 20% in order to account for lower labour cost in Georgia.

The impact will be calculated for three different energy performance levels described below. While the three levels are purely for illustrative purposes, the thermal transmittance values used lie in a range that can be observed in several EU countries.

**Table 4: Description of three energy performance levels used for financial impact assessment**

| Energy performance level | | Thermal transmittance $W/m^2K$ | | | | |
|---|---|---|---|---|---|---|
| | | External wall | Roof | Ground | Window | Combined* |
| **Moderate** | ca. 5 cm insulation layer, double glazing windows | 0.7 | 0.7 | 0.7 | 3 | **1.0** |
| **Medium** | ca. 7 cm insulation layer, double glazing windows with gas filling | 0.5 | 0.5 | 0.5 | 1.3 | **0.6** |
| **High** | ca. 20 cm insulation layer, triple glazing windows | 0.3 | 0.3 | 0.2 | 0.7 | **0.3** |

*Source: Ecofys, own calculations; * thermal loss for reference building*

Meeting the stricter standards requires installing technical measures such as additional thermal insulation or an exchange of windows. Table 4 shows our assumption of the technical measures installed to achieve the foreseen thermal transmittance value.

The **moderate scenario** shows thermal transmittance in case of adding or constructing with 5 cm insulation material and using double glazing windows.

In the **medium scenario** it is assumed that around 7 cm of standard insulation material are added to the envelope as well as advanced double glazing windows with a gas filling.

**High scenario** considers the effect of a 20 cm insulation layer and state of the art triple glazing windows.

In the following section we calculate the corresponding construction cost increase or retrofitting cost which such a set of measure would require. We also calculate the possible energy cost savings and overall profitability for each energy performance level.

Our assessment considers two types of buildings: single family homes and multi family homes. We calculate the financial effect in case of new construction as well as retrofitting for those two types.

### 4.2 Economic viability in case of new construction

To recall, the main impact of the EPB directive lies in the requirement to set (and continuously review) minimum energy performance standards for newly constructed buildings. Table 5 below shows the impact on energy and construction costs of a newly built single family home for three different hypothetical energy performance levels.

*Newly constructed single-family home*

Under the "moderate level" scenario we assume that a newly constructed building has to achieve a combined thermal transmittance value of 1.0 $W/m^2K$ for the entire building envelope – a significant reduction from the value of around 2.0 $W/m^2K$ which we assume to be the current standard for newly constructed buildings ("business as usual").

This is likely to reduce heating energy consumption by 54 kwh/m$^2$ per year compared to the "business as usual" case leading to energy cost savings of about GEL 5 per m$^2$ and year or around GEL 540 per year for a typical house with a size of 120m$^2$.

At the same time, the stricter standard would lead to additional construction cost of around GEL 60 per m$^2$. This represents a **construction cost increase of about 4%[2]** or about GEL 7,200 of additional costs for a 120 m$^2$ home.

The energy cost savings represent an **8% annual return** on the additional investment cost – equal to a payback time of 13 years. This rate of return is rather low when compared with other investment options. Indeed, the net present value of the investment is negative considering the assumed discount rate of 10%. The economic case is even worse for the two other stricter energy performance scenarios.

**Table 5: Financial impact new construction of single family home (SFH)**

| Single family home – new built | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Energy performance level** | Thermal transmittance building envelope | Energy savings | Energy cost savings | Additional construction cost | Simple payback period | annual RoI | Net present value |
| | W/m$^2$K | kWh/ m$^2$year | GEL/ m$^2$year | GEL/m$^2$ | years | | 2017 GEL/m$^2$ |
| **Business as usual** | 2.0 | 0 | | | | | |
| **moderate** | 1.0 | 54 | 5 | 60 | 13.2 | 8% | -21 |
| **medium (EPD scenario)** | 0.6 | 68 | 6 | 85 | 14.9 | 7% | -36 |
| **high** | 0.3 | 82 | 7 | 170 | 24.9 | 4% | -111 |

*Source: own calculation*

*Newly constructed multi-family home*

The economic case of stricter energy performance requirements is slightly better for multi-family homes (see Table 6 below). Under the "moderate energy performance level" scenario, the resulting energy cost savings represent a **9% return on investment** when compared to the construction cost increase triggered by the stricter energy performance requirements. The net present value over the life time is only slightly negative.

Under the moderate scenario we expect the stricter standards to lead to additional construction cost of around GEL 32 per square meter – **an increase of 2% of total construction cost**. This is equal to additional cost of GEL 1,900 for a 60 m$^2$ apartment.

[2] Assuming typical construction costs of GEL 1,500 per square meter.

On the other hand, the improved thermal features of the building would lead to annual energy cost savings of around GEL 3 per square meter – equal to around GEL 180 of energy of cost savings per year for a 60 $m^2$ apartment.

**Table 6: Financial impact new construction of multi-family home (MFH)**

| Multi family home – new built | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Energy performance level** | Thermal transmittance building envelope | Energy savings | Energy cost savings | Additional construction cost | Simple payback period | annual RoI | Net present value |
| | W/$m^2$K | kWh/ $m^2$year | GEL/ $m^2$year | GEL/$m^2$ | years | | 2017 GEL/$m^2$ |
| **Business as usual** | 1.7 | 0 | | | | | |
| **moderate** | 1.0 | 32 | 3 | 32 | 10.7 | 9% | -6 |
| **medium** | 0.6 | 48 | 4 | 49 | 10.9 | 9% | -10 |
| **high** | 0.3 | 62 | 6 | 97 | 17.0 | 6% | -48 |

*Source: own calculation*

**Conclusions:**

The expected construction cost increase due to stricter energy efficiency norms under the moderate scenario are rather modest ranging between 2% for multi-family homes and 4% for single family homes.

The overall profitability of moderate energy performance standards is acceptable and energy cost savings represent a reasonable return on the additional investment costs. Higher standards (as considered in the “medium” and “high”) may at this point of time not yet be economically viable for new construction of single-family homes.

## 4.3 Economic viability in case of retrofitting

The Energy Performance in Buildings directive also foresees setting and enforcing minimum energy efficiency standards in case of major renovation. Additionally the Energy Efficiency directive requires the government to renovate a certain share of public sector buildings per year to meet the new legal standards.

This raises the question of the financial impact for different energy performance levels in case of a renovation of buildings. Which energy cost savings can be expected and how do they compare to the additional cost of retrofitting the building elements to meet the higher legal energy efficiency standards?

*Retrofitting of single-family homes*

Table 7 below shows the financial impact of stricter legal requirements in case of major renovations of single-family homes. Given the current rather low thermal resistance of the building stock, a reduction of thermal transmittance to meet legal standards leads to substantial energy savings and corresponding cost savings.

For the “moderate scenario” we expect energy savings of 143 kWh/$m^2$ and year for a single family home. This is equal to around GEL 80 energy cost savings per square meter or GEL 1300 for a typical house. The corresponding costs for the retrofitting measures are expected to sum up to GEL 9600 (GEL 80 per $m^2$) for a typical home. Overall the energy cost savings that can be achieved represent a 14% return on the retrofitting cost. Thus the economic case for stricter energy performance requirements is good.

It is important to note though that this scenario assumes that the entire building envelope (external walls, roof, floor) is being retrofitted and the windows are exchanged at the same time. In reality it is more likely that only single measures – for example roof insulation in the context of retiling of a roof – are carried out. While we have not assessed measures on their own, it is fair to assume that the economic case for them is similar.

Our assessment suggests that the economic viability is also good for the “medium” scenario which assumes an overall thermal transmittance value of 0.6 W/$m^2$K.

**Table 7: Financial impact retrofitting of single family home (SFH)**

| Single family home – retrofitting | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Energy performance level** | Thermal transmittance building envelope | Energy savings | Energy cost savings | Additional cost of retrofitting | Simple payback period | annual RoI | Net present value |
| | $W/m^2K$ | kWh/ $m^2$year | GEL/ $m^2$year | GEL/$m^2$ | years | | 2017 GEL/$m^2$ |
| **Business as usual** | 3.2 | 0 | | | | | |
| **moderate** | 1.0 | 143 | 11 | 80 | 7.2 | 14% | 15 |
| **medium** | 0.6 | 161 | 12 | 89 | 7.1 | 14% | 19 |
| **high** | 0.3 | 179 | 14 | 133 | 9.6 | 10% | -14 |

*Source: own calculation*

*Retrofitting of multi-family buildings*

Table 8 below shows the financial impact following the retrofitting of a multi-family home in compliance with three different hypothetical legal energy performance standards. The results suggest that especially a retrofit compliant with a “moderate energy performance level” offers a good return on investment. This reflects that heat losses of the existing housing stock are typically rather high and retrofitting measures can offer substantial energy savings.

Again we consider the case where all measures (wall, roof, floor insulation and window exchange) are carried out simultaneously. In reality measures may be carried out separately reducing the total retrofitting cost but also the energy cost savings that can be achieved.

The total cost of retrofitting (if all measures done at once) amount to GEL 76 per square meter or GEL 4,500 in total for a typical apartment of $60m^2$. This represents significant extra cost, especially if the entire building envelope and windows are retrofitted at once. However, in return, the measures are expected to lead to annual energy cost savings of GEL 11 per square meter or around GEL 640 of energy cost savings per year for the whole apartment. This makes the retrofitting measure an investment with a good return of around 14% interest per year.

The economic case is also good for the even higher energy performance standards under the “medium” scenario which would set the legal minimum thermal transmittance value at 0.6 $W/m^2K$.

**Table 8: Financial impact retrofitting of multi-family home (MFH)**

| Multi family home – retrofitting | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Energy performance level** | Thermal transmittance building envelope | Energy savings | Energy cost savings | Additional cost of retrofitting | Simple payback period | annual RoI | Net present value |
| | $W/m^2K$ | $kWh/m^2year$ | $GEL/m^2year$ | $GEL/m^2$ | years | | 2017 $GEL/m^2$ |
| **Business as usual** | 3.2 | 0 | | | | | |
| **moderate** | 1.0 | 115 | 11 | 76 | 7.0 | 14% | 17 |
| **medium** | 0.6 | 130 | 12 | 93 | 7.6 | 13% | 12 |
| **high** | 0.3 | 144 | 13 | 141 | 10.5 | 10% | -25 |

*Source: own calculation*

**Conclusions:**

The economic case of stricter energy performance standards in case of major renovations is convincing and in comparison better than for newly constructed buildings. This reflects the high thermal losses of the existing building stock and the corresponding energy saving potential. It suggests that the same or at least similar level of legal minimum energy performance standards as for newly constructed building can also be applied to major renovations.

## 5. Conclusions and policy recommendations

- Among the Energy Community commitments the Energy Performance in Buildings Directive (2012/31/EU) and the Energy Efficiency Directive (2012/27/EU) are the two directives with the largest expected impact on the building sector.
- Especially, the requirement to set minimum energy performance standards for new construction and in case of major renovations are likely to have a large economic impact through increased construction and renovation costs but may lead to substantial energy cost savings.
- Importantly, the actual level of the minimum standards is not foreseen in the Directive but can be established by the government of Georgia at a level that is deemed cost-effective based on a clear methodology.
- Such an assessment should be carried out as soon as possible to establish the cost effective energy performance level for different building types in order to prepare the implementation of the directive.
- Our own assessment shows that there is a good economic ratio to significantly reduce current practiced standards for thermal transmittance of the building envelope for new buildings. Indeed, many construction companies already voluntarily fulfil higher energy performance requirements than they are legally obliged to.
- Introducing minimum energy performance requirements of around 1 $W/m^2K$ for the building envelope would lead only to moderate increase of construction cost in the range of 2% for multi-family homes and 4% for single-family homes and could be implemented straight away at least for multi-family buildings.

### 5.1 <u>Two staged approach for the introduction of minimum requirements for energy performance</u>

- Introducing new energy performance standards is a major policy undertaking. With that in mind and given that currently no energy performance requirements are enforced, the government may consider a phased, two-staged approach for the introduction of new energy performance standards.

<u>Phase 1 (2018): Limited introduction</u>

- The government should consider introducing moderate energy performance requirements for certain types of buildings projects. During the first phase, the new legal requirements could be initially restricted to newly built larger buildings and for public sector procurement. The level of the standards could be less strict than planned for full introduction which would follow later.
- The public sector would thus lead the way by example as suggested in the EPBD. Especially the Municipal Development Fund, which accounts for a large share of public sector procurement of buildings, could be used to introduce new energy performance standards for newly built public sector buildings.
- A limited introduction of new standards for large building projects and public sector construction would have the advantage for the public administration, especially building inspection offices, to

gain experience with the new codes. Similarly, the construction sector can adjust to new codes, build up experience and qualifications.

- A limited introduction is also likely to lead to a decline in the cost of material and labour connected to energy efficiency measures which will improve the economic case for a more widespread roll-out of the new standards at a later stage.
- In order to support this process, the government should involve and inform all stakeholders about the new requirements as soon as their level will be decided.

Phase 2 (2019/2020): Full roll-out

- In the second phase, the new minimum energy efficiency requirements should be applied at their cost-effective level to all buildings.
- Higher energy performance standards for smaller buildings and single family homes may come in force only later in 2019 as compliance here is more difficult to enforce and the economic case for stricter standards in single-family homes is not yet that convincing.

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