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ECONOMIC AND FINANCIAL IMPACT OF LARGE SCALE ENERGY EFFICIENCY PROGRAMME FOR HOUSING USING THE EUROPEAN UNION STRUCTURAL FUNDS. THE CASE OF LITHUANIA

Summary: During the programming period of 2007-2013, the EU Cohesion Policy has started playing a new and important role in the process of supporting investments into energy efficiency measures in the housing sector, which plays a crucial part in achieving energy savings targets and combating climate change whilst contributing to energy savings and security. The increasing need for the effective renovation of housing stock, which was constructed during the period of cheap energy resources, is most notable in Central and Eastern Europe. The authors present calculations of the main financial indicators, i.e. net present value, internal rate of return, simple payback period, and the cost of conserved energy. Financial indicators are calculated based on the aims and the objectives of the Programme for Renovation of Multi-Apartment Buildings in Lithuania.

Keywords: European Union financial support, energy efficiency, housing.

1. Introduction

During the programming period of 2007-2013, European Union (EU) Cohesion Policy has started playing a new and important role in the process of supporting investments into energy efficiency measures in the housing sector. Housing is at the core of the EU prosperity, as it is important to combat climate change, whilst contributing to energy savings and security.

The increasing need for effective asset management in European cities is the most notable in the New Member States region. The EU itself recognises that the energy intensity of New Member States is still significantly higher than in Old Member States. The potential for energy efficiency in Central and Eastern European (CEE) countries is immense, as most of the region's old multi-apartment buildings stock requires renovation.

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The main purpose of the article is to describe the importance of investment in energy efficiency in residential buildings, present recent innovative financial instrument suitable for this type of investments in the EU as well as assess the impact of the implementation of large scale energy efficiency programme in terms of financial aspects. The subject of the article is the renovation of multi-apartment buildings aimed at increasing energy efficiency. In this article, the authors will present calculations of the following financial values: 1) net present value (NPV); 2) internal rate of return (IRR); 3) simple payback period (SPP); and 4) the cost of conserved energy (CCE).

2. European Union structural funds and investment in energy efficiency: innovative tool for financing energy efficiency in housing

European Investment Bank (EIB) approach to urban investment has evolved pragmatically over the years until current, i.e. 2007-2013 programming period, responding to EU policies and instruments. Urban renewal and social housing, alongside urban transport, became eligible for EIB funding within the environmental objective in 1988, as well as the mix of financial products within the field of urban development, lending has increased at an accelerating rate [European Investment Bank 2005]. Since 1997, EIB role has grown because the urban development mandate was extended at the Amsterdam Summit in 1997, in particular regarding social housing [Expert Working Group... 2007]. In terms of energy efficiency, over five years from 2006 to 2010, EIB contributed 18 billion EUR to projects which have a direct impact on improving the energy efficiency in and outside the EU. Approximately 1.9 billion EUR was contributed to the increase of energy efficiency in building and another 0.5 billion EUR in industry [Idczak 2011].

Recently EIB has started supporting convergence through special programmes developed in co-operation with the European Commission to enable the most efficient and sustainable use of Structural and Cohesion Funds in the 2007-2013 programming period. One of the new products developed by EIB in co-operation with the European Commission and the Council of Europe Development Bank (CEB) in 2005 is a new initiative – Joint European Support for Sustainable Investment in City Areas (JESSICA). It is an optional financial instrument intended to address the lack of investment funds to finance integrated urban renewal and regeneration projects and facilitate accelerated investments in urban areas in the context of the Cohesion Policy [European Investment Bank 2010].

The managing authorities of Member States can use payments from their structural fund allocations by placing funds into either the urban development fund or the holding fund. Programme contributions to urban development funds are in the form of revolving finance to make the investment more sustainable and trigger significant leverage effects [Directorate-General for Regional Policy 2009].

An illustration of the increasing need for effective asset management in many European regions is most notable in the area of energy efficiency. The EU also recognises the need for rapidly mobilising cost-effective energy efficiency improvements in the built environment to achieve the relevant targets. The European Council of March 2007 emphasised the need to increase energy efficiency in the EU so as to achieve the objective of reducing by 20% the EU's energy consumption by 2020 and called for a thorough and rapid implementation of the priorities. Energy savings in the buildings sector contribute to 30% of the whole sector's expected energy consumption by 2020. These savings are expected to lead to significant economic, social, and environmental benefits [European Commission 2008].

In the former eastern-bloc countries the need for refurbishing or reconstructing massive estates of pre-fabricated apartment blocks erected by communist regimes is one of the major challenges in their pursuit of convergence towards income and welfare standards prevailing elsewhere in Europe [Turro *et al*. 2008]. Investments in energy efficiency in housing are crucial for CEE countries as they can deliver multiple benefits, for example contribute to the reduction of approximately half of energy-related greenhouse gas emissions as well as energy use, thus lowering energy bills and reducing the country's dependence on external fuel suppliers. One of the main benefits of buildings renovation could be achieved in the constructions sector, i.e. large scale renovation programme conditions a need for a large amount of new workers and the demand for workers will be spread across all levels (new construction entrepreneurs, for college-trained professionals, skilled workers and unskilled workers). In addition, the savings caused by the reduction in energy consumption, plus the additional consumption fuelled by the wages of the additional jobs created, should increase the disposable income of families – income that, when spent, will generate additional induced benefits to employment [Ürge-Vorsatz 2010].

JESSICA is already set to play an important role in the area of energy efficiency in such countries as Lithuania, Spain, Great Britain, and Greece, where in total some 500 million EUR of long-term capital investment into energy efficiency for housing, public buildings, and other urban infrastructure is going to be transferred using the initiative [European Investment Bank 2010]. Financial calculations related to one of the largest and one of the most advanced JESSICA operation to date is presented in the following section.

3. Large scale energy efficiency programme for housing using the European Union structural funds. The case of Lithuania

The majority of the Lithuanian population, i.e. 66%, reside in multi-apartment buildings constructed between 1961 and 1990 [*Daugiabučių namų atnaujinimo*... 2004]. Those years could be characterised as the period when energy resources were cheap, which conditioned a poor focus on energy-efficiency measures at the time of building new housing [Serbenta 2009]. The publicly owned rental housing

stock was privatised to a high extent; however, no sufficient attention was paid to the establishment of an institutional and legal system for its maintenance and exploitation and for this reason housing maintenance problems arose. To date, only 20% of the total number of apartment buildings have been managed and maintained by the housing owners who have established home owners' associations [*Lithuanian housing strategy*... 2004].

Recent economic trends in Lithuania as well as in other Member States implied the deteriorating supply of financing. With shrinking public budgets and limited access to bank loans during the economic crisis, CEE countries had to turn to EU funds to unlock the potentials, leverage private capital, and facilitate the transition towards a low carbon future [CEE Bankwatch Network 2009]. In this context, the Government of the Republic of Lithuania decided to implement new innovative tool for financing urban development and suitable for funding energy efficiency investments, i.e. JESSICA. On 11 June 2009, the Ministries of Finance and of Environment of the Republic of Lithuania established the JESSICA holding fund in Lithuania (JESSICA Holding Fund) in the amount of 227 million EUR, which is managed by EIB on behalf of the Lithuanian authorities.

Until 2015, JESSICA Holding Fund aims to finance 1,000 multi-apartment buildings and achieve 30% of the effectiveness of energy consumption in the renovated housing stock [*Lietuvos Respublikos Vyriausybės nutarimas*... 2008]. According to the Law on Support for Housing [*Lietuvos Respublikos valstybės paramos*.... 2009], the annual fixed interest rate on the modernisation loans granted to the final beneficiaries will not exceed 3% for the whole term of the loan grated for renovation projects, i.e. for the period of 20 years. The Lithuanian government also provides support of 15% of investments, which fall to the measures of energy efficiency in the case of the achievement of necessary energy efficiency class. In accordance with the Programme for Renovation (Modernisation) of Multi-apartment Buildings (Programme) [*Daugiabučių namų atnaujinimo*... 2004], state support is provided to home owners of multi-apartment buildings, which were built in accordance with the construction permits issued before 1993.

The following part of the paper will be devoted to financial aspects related to the implementation of the Programme, which is implemented using EU structural funds. The following financial indicators are analysed: 1) NPV; 2) IRR; 3) SPP; and 4) CCE. Since impact is determined by the scale and schedule of the Programme, this paper is focused on specific period and scope of the renovation, i.e. the renovation of 1000 multi-apartment buildings by 2015 (JESSICA Holding Fund physical output target [*Lietuvos Respublikos Vyriausybės nutarimas*... 2008]).

The authors use the results of the monitoring studies of the Programme implemented by the Lithuanian government during the period between 2005 and 2009 (monitoring studies) as the basis for calculations of the impact of the Programme, using JESSICA financial instrument [Rogoža *et al*., 2007; Rogoža *et al*. 2008; *Daugiabučių namų modernizavimo*... 2009].

3.1. Net present value

Net present value is one of the main financial indicators using the time value of money to appraise long-term projects. In the case of this research, the following formula was used:

$$NVP = \left(\sum_{i=1}^{N} \frac{S_i^T}{(1+r)^i} \right) + S \tag{1}$$

where S – amount of the investment project (negative), r – discount rate[2], S_i^T – funds earned during i^{th} period, N – number of periods.

For the calculation of funds earned during i^{th} period (S_i^T in equation (1)), the authors used the following formulas of heat energy price and energy savings. The following formula presents calculations for the price of heating energy:

$$\check{S}EK_i = \check{S}EK_{i-1} \times (1 + BVP_i) \tag{2}$$

where $\check{S}EK_i$ – price of heating energy during i^{th} year; BVP_i – projection of i^{th} year GDP[3].

Table 1 presents GDP growth for the period between 2011 and 2015. The authors make an assumption that an increase of GPD starting from 2015 and onwards is stable and reaches 3.4% each year.

Table 1. GDP growth/chain-linked volume growth, percentage

	2011	2012	2013	2014	2015
GDP growth	5.8	4.7	3.7	3.4	3.4

Source: [Finansų ministerija 2011].

Table 2 presents heat energy prices during 2009 and 2010.

Table 2. Heat energy prices, year 2009 and 2010

2009	2010
220 LTL/MWh	230 LTL/MWh

Source: [Lietuvos šilumos tiekėjų asociacija 2011].

For the purpose of estimating energy savings, the authors calculate average heated area of one multi-apartment building based on the figures presented in the monitoring studies. The formula of calculating average heated area is as follows:

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[2] Discount rate of 3% is used for calculations.

[3] In this study authors make an assumption that the change of heating energy price is directly related to the change of GDP and that it changes at the same pace.

$$\overline{S} = \frac{\sum_{i=1}^{N}\sum_{j=1}^{M_i} S_j^i}{\sum_{i=1}^{N} M_i} \approx 3{,}074\ m^2, \tag{3}$$

where $\overline{S}$ – average heated area of the multi-apartment building; N – number of implemented monitoring studies; M_i –the multi-apartment buildings assessed in i^{th} monitoring study; S_j^i – i-average heated area of j^{th} multi-apartment building in i^{th} monitoring study.

In order to calculate annual energy savings, the authors use the following formula, which is also compiled using the results of the monitoring studies:

$$\overline{E} = \frac{\sum_{i=1}^{N}\sum_{j=1}^{M_i} \frac{E_j^i}{S_j^i}}{\sum_{i=1}^{N} M_i} \approx 72.4\ \frac{kWh}{m^2}, \tag{4}$$

where $\overline{E}$ – annual energy savings of the multi-apartment building; N – implemented monitoring studies; M_i – renovated multi-apartment buildings assessed in i^{th} monitoring study; E_j^i – average annual energy savings of j^{th} multi-apartment building in i^{th} monitoring study; S_j^i – average heated area of j^{th} multi-apartment building in i^{th} monitoring study.

As the Lithuanian government provides support for 15% of the investments which fall to the measures of energy efficiency, the authors use two values of the amount of the energy efficiency projects: 1) amount/m^2 of the investment project in general which is equal 254 LTL/m^2 [4]; and 2) amount per m^2 invested by the home-owner when in he or she gets 15% of subsidy, i.e. 216,67 LTL/m^2. Therefore, two types of values of NPV are calculated: (i) taking into account NPV in general, i.e. 124.07 LTL/m^2; and (ii) NPV taking into account reduced investments to the final beneficiary, i.e. 162.31 LTL/m^2.

3.2. Internal rate of return

Another important financial indicator is IRR. It is the rate of return often used in capital budgeting that makes NPV of all the cash flows from a particular project equal to zero. In this study, the authors use the following formula for calculation:

$$\sum_{i=1}^{N} \frac{S_i^T}{(1-IRR)^i} = NVP = 0 \tag{5}$$

where, S_i^T – funds earned (saved) during i^{th} period; N – total number of periods[5].

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[4] Calculated taking into account the amount of the Programme using JESSICA, i.e. 1,000 multi-apartment building and total current amount of investments, i.e. 227 million EUR.

[5] Authors take 20 periods for calculations.

As in the case of NPV, IRR is calculated in two cases: (i) IRR in terms of investments in general which equals 3.86%; and (ii) in the case of smaller investment taking into account subsidy of 15% for energy efficient measures. In this case IRR equals 5.66%.

3.3. Simple payback period

SPP refers to the period of time required for the return on an investment to repay the sum of the original investment. The authors use simple formula to calculate SPP of energy efficiency projects in the multi-apartment buildings:

$$SPB = \frac{S}{\overline{S}^T} \tag{6}$$

where, S – amount of investment; $\overline{S}^T$ – average of annual savings. The results of the calculations made for this indicator are presented in Table 3.

3.4. The cost of conserved energy

This indicator helps to evaluate if it is cheaper to save or to consume energy, for example the cost of energy achieved by using energy efficiency measures is 100 LTL/MWh. At the same time, the price of heating is 110 LTL/MWh. Therefore, it is clear that in this case, an investor (or policymaker) should take a decision to save and not to consume energy [Martinaitis *et al*. 2004].

Another advantage of CCE is that its numerical value does not depend on the current or future energy prices. For example, if the CCE value is obtained higher than the current price of heat, but lower than expected future price, then we can say that it is worth investing in such an energy efficiency project. The following formula presents calculation of CCE:

$$SEK = \frac{I}{Q_s} \times \frac{d}{1-(1+d)^{-n}} \tag{7}$$

where SEK – CCE; I – amount of investment; Q_s – energy savings per year; n – lifetime of investment d – discount rate.

As in both previous cases, two values of CCE are calculated: 1) in the case of whole project investment – 236.65 LTL/MWh; and 2) in the case of smaller investment taking into account subsidy of 15% – 201.15 LTL/MWh. Table 3 presents results of the calculations and summarises the main results of evaluation.

Table 3. Results of financial calculations

Financial indicator	Measurement unit	Value	
		For the whole amount of energy efficiency increase in multi-apartment buildings investment projects	Taking into account 15% of state subsidy when minimum determined energy efficiency class is reached
Net present value (NPV)	LTL/m^2	124.07	162.31
Internal rate of return (IRR)	percentage	3.86	5.66
Simple payback period (SPP)	years	10.00	8.5
Cost of conserved energy (CCE)	LTL/MWh	236.65	201.15

Source: compiled by the authors and based on their calculations.

4. Conclusions

Housing is at the core of EU's prosperity as it is important to achieve EU's energy savings targets and combat climate change whilst contributing to energy savings and security. The adaptation of the JESSICA instrument to the housing modernisation projects in Lithuania is an example of using EU structural funds for the increase of energy efficiency in the housing sector by implementing large scale renovation project. Essentially, several related conclusions could be presented, based on the calculations in this article.

In general, taking into account the general aim of EU financial instrument, which Lithuania uses for the increase of energy efficiency in housing, JESSICA will contribute to the creation of a sustainable financial mechanism aimed at managing various housing-related problems in urban areas as well as more general social, political, and economic policy agenda challenges, such as the development of the construction sector, better living conditions, new business opportunities, increased market value of real estate, as well as improved air and life quality and health. Finally, the energy efficiency programme designed with the support of the EU during the period 2007-2013 could become a pattern to be replicated in future EU structural funds programming periods.

This article included calculations of the following indicators: 1) NPV; 2) IRR; 3) SPP; and 4) CCE. The results indicate that the energy efficiency investment projects in multi-apartment buildings in Lithuania should be financially efficient in both cases, i.e. when calculating whole amount of investments and when calculating only 85% of the investments in the case of state subsidy of 15% provided to home-owners of multi-apartment buildings.[6] SPP is quite short (around nine years), CCE is lower than heat energy price, both NPV and IRR are positive.

[6] At the discount rate of 3%.

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SKUTKI FINANSOWE I EKONOMICZNE PROGRAMU WSPIERANIA ENERGETYCZNEJ EFEKTYWNOŚCI SKALI W MIESZKALNICTWIE PRZY UŻYCIU FUNDUSZY STRUKTURALNYCH. PRZYPADEK LITWY

Streszczenie: W okresie programowania w latach 2007-2013, polityka spójności Unii Europejskiej zaczęła odgrywać nową, istotną rolę w procesie wspierania inwestycji w efektywność energetycznej w sektorze budownictwa mieszkaniowego. Sektor ten ma kluczowe znaczenie w osiąganiu celów oszczędności energetycznej i przeciwdziałaniu zmianom klimatu. Rosnące zapotrzebowanie na efektywną renowację zasobów mieszkaniowych, zbudowanych w czasach łatwiejszej dostępności zasobów energetycznych, uwidacznia się najbardziej w obszarze Europy Środkowo-Wschodniej. Autorzy przedstawiają kalkulacje podstawowych wskaźników finansowych, tj. wartości bieżącej netto, wewnętrznej stopy zwrotu, prostego okresu zwrotu i kosztów oszczędzonej energii. Wskaźniki finansowe zostały obliczone w oparciu o cele Programu Renowacji Bloków Mieszkaniowych (przy wykorzystaniu programu JESSICA) na Litwie.