MANAGING THE SOCIO-ECONOMIC IMPACT OF ENERGY EFFICIENT HOUSES IN ROMANIA

Andreea OGREZEANU[1], Anca Alexandra PURCĂREA[2], Vladimir TANASIEV[3]

Romania, aligned with Europe's energy strategy, has a soon coming deadline with regards to the energy efficiency of its residential buildings. Starting with 31st December 2020, as stated in EU Directive and in national legislation, new build houses need to be compliant with a standard diminishing the consumption of energy from conventional sources nearly to zero. This paper is looking into the processes that might unfold for Romania going through this transition. The paper presents the results of a consultative process addressed to relevant stakeholder in order to anticipate possible socio-economic impacts and to contribute to the design and the solution for Romania. The paper argues that data regarding the social impact of this change should be included in decision making along with technical and economical considerations.

Keywords: NZEB, passive houses, social impact assessment, participative process, energy efficient houses, industrial engineering

1. Introduction

Energy efficient houses are an important focus in today's European discourse on energy strategies. The target for Europe is to reduce with approximatively 90% the consumption of energy 2050, compared to the 1990 level of consumption (European Commission, 2011). In this context, important targets are assigned to buildings' energy performance with deadlines very soon due, as buildings are responsible with approximatively 40% of the final energy consumption and 36% of greenhouse gasses emissions. According to European directive 2010/31/EU, adopted by our national legislation, Law 372/2005, starting with December 31, 2020 the residential buildings should respect new requirements with regards to energy performance of the residential buildings. For public buildings the deadline was December 31, 2018. Questions with regards to what energy performance of buildings entails require terminological clarifications. The law refers to NZEB (nearly zero energy buildings), while a voluntary

[1] PhD Student, Faculty of Entrepreneurship, Management and Business Engineering, University POLITEHNICA of Bucharest, Romania, e-mail: ogrezeanu.a@gmail.com

[2] Prof., *Faculty of Entrepreneurship, Management and Business Engineering*, University POLITEHNICA of Bucharest, Romania, e-mail: apurcarea@gmail.com

[3] Lect., Faculty of Power Engineering, University POLITEHNICA of Bucharest, Romania, e-mail: vladimir.tanasiev@upb.ro

standard very popular in Europe refers to passive houses. What each one of this entails and what are other terms to refer to energy performant houses, we will tackle in the following section of this paper.

The new energy efficiency standards are raising a lot of questions with regards to what impact these new standards might have. This paper is concerned with the socio-economic impacts of these changes. Designing the solutions to obtain an improved energy performance is aligned with the technological advances and trends of the fourth industrial engineering. A blend of technologies for better insulation, renewable energies, automations, and others were put together to achieve this aim. We argue that considering, along with the technical aspects, also socio-economic impacts will produce a much more sustainable solution. Adopting the new standards in Romania calls for interdisciplinary approach that requires the contribution of specialists from different disciplines and will have an impact on the final consumer also.

As part of a doctoral research, a socio-economic impact assessment and a consultative process were started. Social impact assessment (SIA) is a complex methodology developed and applied for the past 50 years in engineering domains, the literature provides a lot content with theoretical distinctions and practical considerations [2], [3]. [1], [14]. In this research, the consultative process invited different stakeholders to anticipate what the socio-economic impact of energy performant houses will be when the law comes into force. Architects, engineers, researchers, specialists from business environment and from academia responded to a questionnaire collecting their opinions and perceptions with regards to this change. In the following section a selection of this data is presented, the focus being how the anticipated impacts are transformed into actionable outcomes and contribute to decision making process.

2. New regulations on houses' energy performance, the existing real estate fund and energy efficient models of houses for Romania

Energy strategies in Europe and elsewhere include as an important component an improved energy performance of buildings. The proposed solutions differ depending on different kinds of determinants among which climatic region, available materials and technologies, tradition, etc.

Energy performance of buildings is defined as "[…] the amount of primary energy needed to meet the energy demand associated with typical use of the building." [4].

The conversation about energy efficient houses includes different models and terminologies such as: passive houses, nearly zero energy buildings (NZEB), active houses, flexible energy buildings, intelligent houses, green houses, carbon neutral buildings.

The main objectives for a house with high energy performance include:

- Low consumption of energy from conventional sources;
- Increased performance of thermal insulation (no thermal bridges, air tightness);
- Indoor air quality, healthy rate of humidity and elimination of indoor air pollutants like carbon monoxide, formaldehyde, volatile organic compounds.

One of the most popular energy efficient model of house in Europe is the passive house, there are specialists who recommend this as a starting point to obtain NZEB requirements [15],[10].

Passive house is the voluntary standard, with an experience of over 25 years in Europe. While NZEB is the definition proposed by the European Directive and adopted by national legislation of member states.

While there are general principles and objectives stated by the European strategy for energy, each member state defines its specific requirements for the adoption of NZEB, depending on different factors such as: climatic region, the national energy system. NZEB according to the Romanian law 372/2005 republished (and more recent legal documents OM 2641/2017, OM 386/2016), is a building with energy consumption almost equal to zero - a building with very high energy performance, where energy consumption is almost zero or very low and at least 10% of theenergy comes from renewable sources, including renewable energy produced on-site or nearby.

Table 1

Synthesis table - Optimal cost and maximum allowable primary energy limit for NZEB buildings for climate zone II (Source: MDRAP, 2014)

The type of building	The optimal cost range [kWh/m2an]	Maximum admitted value for NZEB [kWh/m2an]
Public building and office building	62-100	57
Block of flats	56-112	100
Single-family residential building	155-230	111

The recently adopted in Romania prosumers' law (Law 220/2008, amended by Law 184/2018) furthermore is due to transform buildings into active players on the energy market [3].

Reaching the NZEB target needs to consider the baseline of the existing stock of buildings in Romania that have a rather overall low energy performance. [7]

Passive house certification is more restrictive, establishing higher performance criteria to be fulfilled. As a short definition, a passive house is an energy efficient building, offering a comfortable living environment, throughout

the year, using unconventional heating and cooling systems. A passive house can reduce the energy consumption for heating and cooling with up to 90% compared to a regular building and up to 75% compared to a newly build building.

In broad terms, a passive house must meet three performance criteria [17]:

- Each energy demand for heating and cooling must be less than 15 kWh/m^2year.
- Primary energy demand must be less than 120 kWh/m^2year for all domestic applications (including heating, cooling, electric appliances, hot water, etc.).
- Air changes between interior and exterior must be less than 0.6 h^{-1} at a 50 Pa pressure difference (as verified by the blower door test).

Currently, in European Union there are built more than 150000 certified passive houses, following an exponential trend [16]. Due to the high initial investment cost, most of them are built in Germany Austria and Belgium. Nonetheless, passive house standard is ideal for developing NZE buildings.

3. Identifying and consulting the stakeholders

The new energy performance standards are about to impact several categories of institutions and professionals and general population, the consumers of these new houses. The considered list of stakeholder for the consultative process includes the following:

1. Education and research – Universities; Research institutes.
2. Public institutions - City halls; Environment agencies.
3. Professionals – Architects; Construction/civil engineers; Energy auditors
4. Business environment - Real estate developers; Construction companies; Producers of construction materials; Automations; Energy companies (renewable sources); Professional associations.
5. Final consumer
6. NGOs – Environment; Cultural patrimony; Community development.

An ex-ante consultative process was included in the research aimed to explore with the specialists what the socio-economic impact of energy efficient houses might be. Which is their attitude with regards to different technical solutions and with regards to different possible alternatives of adopting these standards in Romania. Furthermore, the research is concerned with how the data resulting from this consultative process can be integrated in the decision-making processes with regards to adopting and implementing these new standards.

The consultative process included a questionnaire addressed to specialists. The questions were grouped around the following sections: perceptions and attitudes with regards to different technical aspects concerning energy efficiency

of the houses, possible socio-economic impacts of energy performant houses, socio-demographics.

The proposed impacts resulted out of the exploratory interviews with specialists, comparative reports regarding adoption of energy performance in other EU member states, regulations, etc.. The resulted list of possible impacts to be explored with the specialists was grouped into the following categories of impacts: technical, financial, social, environment, health, legal.

Methodological clarifications on the application of the questionnaire:

- The questionnaire was designed as an online form using JotForm platform;
- A list of organizations and specialists was gathered over several months of meetings and attending relevant events/conferences/seminars, most of them were from/in Bucharest but the conversation extended to organizations and specialists from other universities and research centers from: Timișoara, Cluj and Târgu Mureș;
- The link to the online form was sent via email and social networks messages to over 300 contacts and was redistributed by organizations and specialists toward their pears, a method known as snowball sampling;
- Self-completion of the questionnaire requires in average 30 minutes;
- The form was launched on the 4th of July, 2018 and until 28th of September 2018 a number of 66 questionnaires were filled.

The resulting data represent the perceptions and attitudes of a group of stakeholders in the domain of designing and building houses. The starting point of this exploration is that determining perception and attitudes contributes to anticipating behavior

Who are the respondents:

- Almost 40% of the respondents studied an engineering field (construction, energetics, and, a smaller percent automatics);
- The predominant majority of respondents are graduates of higher education;
- They are mostly from Bucharest with a few respondents from: Timișoara, Tg. Mureș, Brașov;
- Age: 43,9%, 38 – 29 de ani; 27,3%, 48 – 39 de ani; 9,1%, 58 – 49 de ani; 6,1%, 68 – 59 de ani.

For each category of socio-economical impact, several scenarios were proposed and the respondents evaluated the positive or, respectively, the negative impact for that possible course of action. They also could have dismissed a scenario altogether if they considered that is not a realist possible scenario.

For the actors within the business environment this change could have both positive and negative aspects. According to the stakeholders responding to this consultation, on the positive side there are: the possibility to develop new products and services based on innovative technologies; continues vocational training opportunities and human resources development; new suppliers on the market bringing in innovation. On the negative side the answers of the stakeholders mention: insufficient technologies, materials and services to respond to the requests; some companies might not adapt to the new requests and they will cease their activity; unemployment for professionals who will not update their expertise and skills according to the new requirements; insufficient personnel to deliver materials, services and equipment; insufficient suppliers to install renewable energy capacities for houses, etc.

Another category due to be impacted by the new energy performance standards for houses are the consumers. Apart from the buying decision that depends on the consumers, also their behavior influences the energy performance of the house.

These are just a few examples of possible impacts for two categories of stakeholders: the business actors and the final consumers. For all the other categories of impact similar data were collected and analyze. Based on this analysis, we could extract a synthetic overview of positive impacts and, respectively, negative impacts, based on the opinion collected from the stakeholders.

The following figures present a synthesis with possible positive and, respectively, negative impacts, as resulting from the data analyzing.

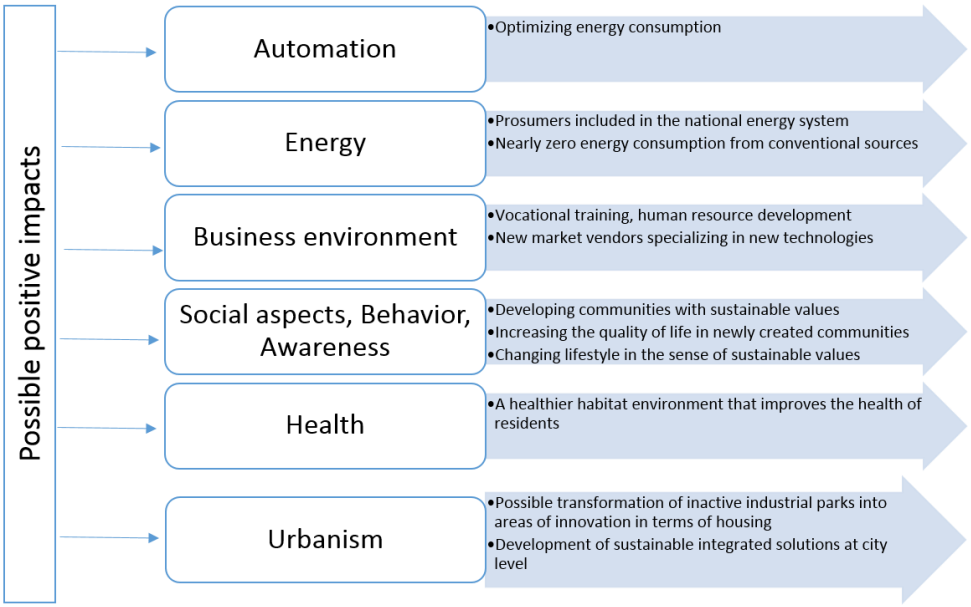

Fig. 1 – Possible positive impacts

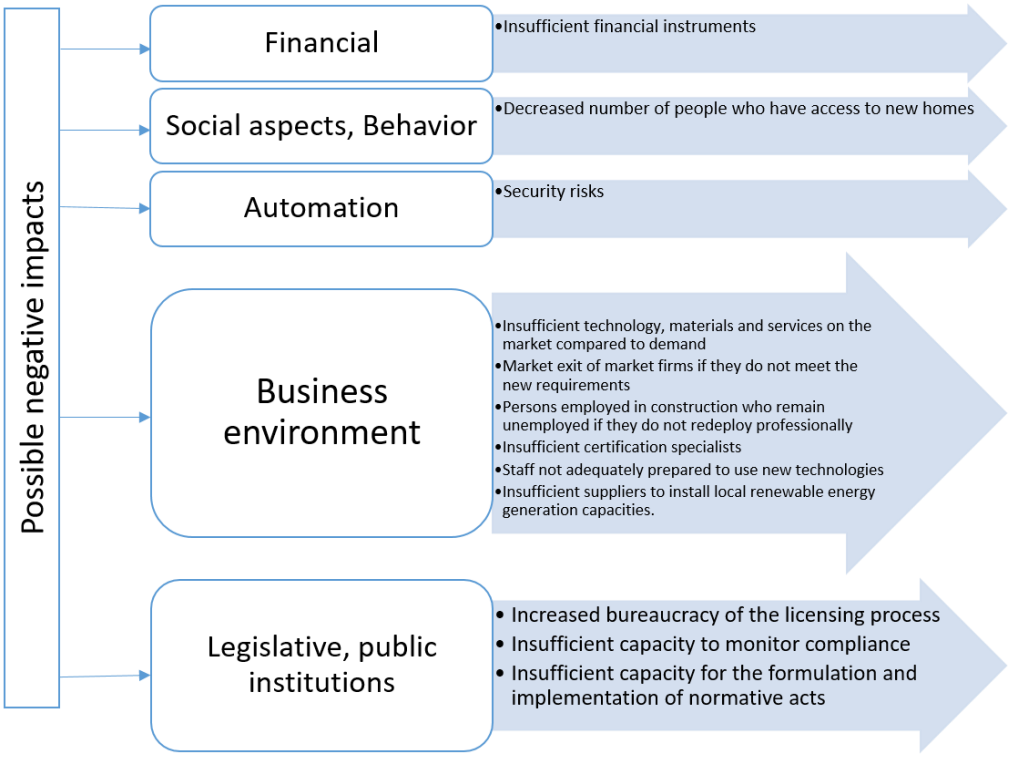

Fig. 2 - Possible negative impacts

According to stakeholders, the possible positive impacts include aspects such as: reduced energy consumption due to automations; possibility to include prosumers within the national energy system; development opportunities for businesses; human resources development opportunities; develop sustainable communities and awareness; increase quality of living and life through healthier dwellings; possibility to develop sustainable integrated urban planning solutions. Among the possible negative impacts were mentioned: insufficient financial instruments to support investment; diminished number of persons who will have access to building new dwellings; business environment might not be ready to respond to the demand with sufficient materials, know-how, human resources; public institutions might not be ready to adopt the new regulations and the authorization system might become more bureaucratic.

While this are the starting point of a consultative process that needs to be extended and continues throughout the adoption and implementation of NZEB in Romania (and other energy efficient initiatives), the insights provided by the specialists could be transformed into measures due to reduce negative impact and to better value possible positive impacts. The following section exemplifies how, using SIA methodology, these insights could be the starting point for actionable outcomes.

4. Managing socio-economic impact integrated in decision making process

SIA methodology proposes that following impact assessment, ex-ante or ex-post, depending on the project, a proses of managing impacts is proposed. The aim is to mitigate negative impacts and to facilitate and harness the positives.

> *"Social impact assessment is the process of analysing (predicting, evaluating and reflecting) and managing the intended and unintended consequences on the human environment of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions so as to bring about a more sustainable and equitable biophysical and human environment." [13]*

The changes generated by the new NZEB requirements stated by the law generates implication on different level for various public and private actors, from macro to micro. These include levels such as: legislative; standards and principles for NZEB in Romania; technologies, materials available on the market (construction, renewable energies, automation); architecture, drafting; construction; usability final consumer. For each of these levels there could and should be criteria based on SIA to support decision making. Out of these logic we propose a tridimensional decision-making model that includes technical, economic and social considerations. Some of this considerations for each component as it is following:

- Technical – principles due to provide a framework guiding towards the required energy performance. With regards to NZEB there is not a universal solution for all houses but it is rather about design principles that should consider key aspects such as: climate zone; the site on which the house is made; volumes; orientation; design; materials available; effective technical systems (ventilation, AC, heating, lighting, automation); renewable energy sources available;
- Economic – optimal cost considering initial investment; current costs with energy and maintenance; costs to eliminate greenhouse effects;
- Social – perceptions, attitudes, behaviors both of the specialists and of the final users. In relation to the specialists who contribute to the design and construction of energy efficient houses key considerations are the following: unitary key concepts definitions; an integrated way to consider and include all the technologies that contribute to increased energy performance. In relation to the final users, key aspects that need to be considered are: social imaginary about housing, physiological aspects about inhabitance; required

behavior to maintain the energy performance of the house; increased awareness with regards to houses' energy performance.

Based on the data resulting from the consultative process, the following figures propose a series of measures following the data resulted from impact assessment, based on the opinion of relevant specialists.

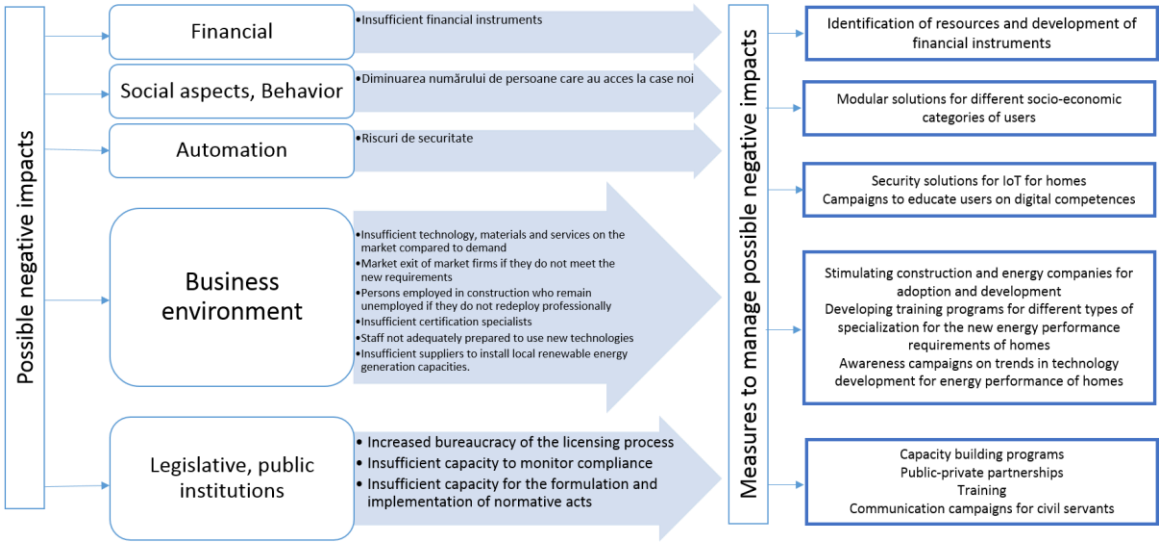

Fig. 3 – Positive impacts facilitation measures

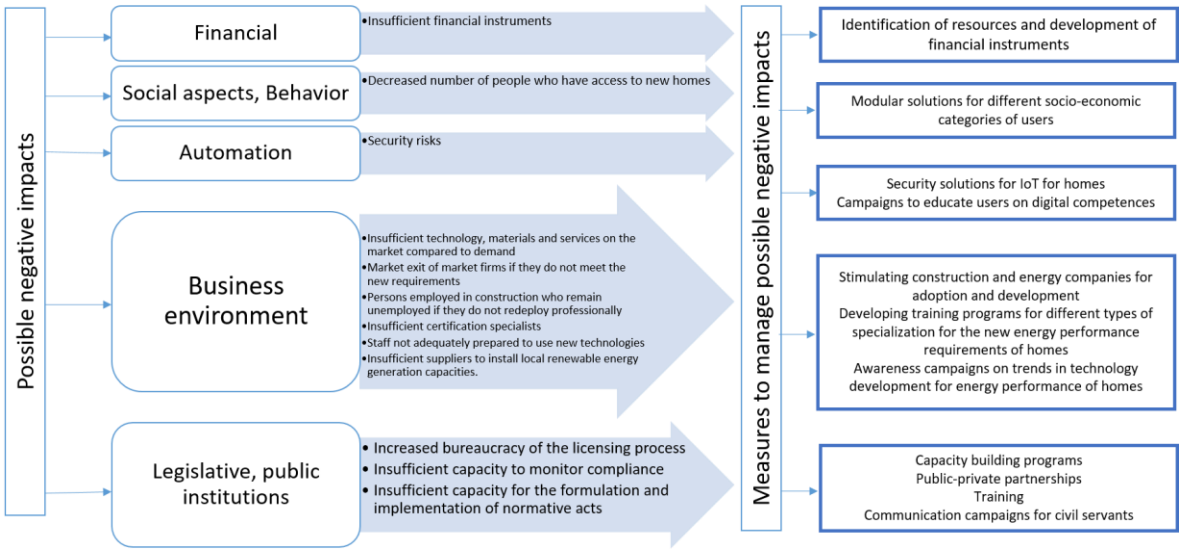

Fig. 4 – Negative impact mitigation measures

According to SIA, these data should be integrated by a Social Impact Management Plan, which should monitor the implementation of the proposed measures. The complexity of the planned intervention in this case, adoption of NZEB in Romania, is due to impact many different actors. This is why consultative and monitoring tools should accompany the process from design and throughout implementation. While there are some poles of innovations in Romania, academic projects, research projects, pilot houses, after almost 40 years since the passive house standard has been defined in Europe for Romania, energy performance houses remain a niche concept. Moving from here towards adopting energy performance as standard requires not only technical solution but other aspects regarding:

- Multi-disciplinary networks, other examples in Europe provide an example in this regard, the need for specialists from different domains to collaborate [6];
- Develop institutional capacity;
- Continuous vocational training;
- Increase awareness (for specialists, public clerks, final consumers, etc.) with regards to the impact of energy performant houses;
- Changes in habitation.

5. Conclusions

This is the beginning of a consultative process and a process of managing social impact of energy efficient houses that is much more complex. This is an ex-ante stage that could be extended throughout the implementation of these new requirements for the houses. Further consultations and data collection could be narrowed down to a specific focus or extended, depending on the perspective of the actors involved.

The adoption of the new requirements should include a complex set of actions from designing methodology and terminology, to education-promotion-communication, implementing and monitoring. All these should invite the contribution of relevant stakeholders in defining and adopting sustainable solutions.

This paper provides an exemplification of how SIA and its consultative tools could contribute to assessing and managing socio-economic impacts of a planned intervention. The final aim being designing and implementing sustainable energy efficient houses in Romania.

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