Enhance energy efficiency of the housing stock in Ukraine (EEEU) through energy performance certificates

Authors: Massimo Mobiglia, Dr. Arch., massimo.mobiglia@supsi.ch, www.isaac.supsi.ch
Ivan Curto, Davide Tamborini, Marco Bellardi, Alessio Vacchio

The proposed project, developed in partnership with leading agencies dealing with energy management of the built environment, aims to support Ukraine in adopting appropriate tools to assess the energy efficiency of its residential housing stock by employing a contextually adapted version of PETRA. This methodology is currently used in Switzerland to assess the energy efficiency refurbishment potential of multi-apartment buildings, which includes the energy performance certificate of a building. In Ukraine such tools are currently missing, but are recognised by the Government and local authorities as being urgently needed to achieve progress in reducing energy consumption in conditions of increasing energy prices and decreasing levels of income, and overall conditions of economic and political crises. The project will further provide an important contribution to improving the draft law on EPC (legislative recognition of demands), drafting policies and laws for the introduction of ЕРС.
1. Scope

1.1 Introduction

Under former socialist regimes most of the residential housing stock in Eastern Europe was built, owned, and managed by the government. Its quality varies across countries, but has in common that many of its multi-apartment building were built in the 1970 when technologies and awareness about energy saving insulations were still rather underdeveloped. Following the dramatic political changes of the early 1990s, residential multi-apartment buildings were largely privatized. Tenants without previous experience in managing common properties suddenly found themselves as sharing collective responsibility over the maintenance of their condominiums. The adequacy of the institutional frameworks that were created to this aim varies across countries but in most cases the currently prevailing poor condition of multi-apartment buildings reflect a combination of problems, such as shortcomings in the quality of construction and lack of maintenance due to poor governance, financial constraints and the lack of social capital.

As a consequence of urbanization in the 19th and early 20th century in Europe, high density or urbanizing areas became a determining factor of construction policies as land became scarce and expensive. The typical building type in a city was the multi-floor tenement house with rental apartments, owned by the developers or investors. Owner-occupied multi-unit buildings gained importance after World War I. The existing urban housing stock was nationalized and transferred into state or municipal ownership in most socialist countries after World War II (Turner et al. 1992). While inner city tenement buildings, now converted into some form of public or shared ownership, remained an important form of multi-apartment housing, new urban housing investments were dominated by multiunit high-rise buildings in housing estates, typically located in the outer ring of cities. From the late 1960s to the end of 1980s, prefabricated construction technologies became the most widespread form of urban housing development. This phase coincided with a period of forced industrialization, accompanied by robust urban construction, which took place in many of the socialist countries. Therefore, 60% of the housing stock in a typical socialist city consisted of prefabricated multiunit blocks, managed by state-owned companies, condominiums and housing cooperatives, which in all cases functioned very similarly to state-owned companies. Tenants and owners had little influence on decision making related to the management of the housing stock, but housing costs were kept very low (Turner et al. 1992).

The quality of the prefabricated high-rise housing estates built between 1960 and 1980 varies greatly between different post-socialist countries. In former Yugoslavia, Hungary and Czechoslovakia the quality was comparatively higher, while Moldova, Russia, and Bulgaria constitute the other end of the spectrum. One extreme case is represented by the five-floor apartment buildings in Russia and Ukraine known as "khrushchevki". Urban housing estates occupied a special status in socialist housing policies. They were well located, typically had good infrastructure (roads, schools, health institutions, etc.), and were well connected to public transportation. However, the management companies have long neglected their maintenance. This applies in particular to the relatively new housing estates, where in some cases no maintenance has taken place since the beginning of their existence. While this situation could have led to a fast physical as well as social degradation of related neighborhoods this has fortunately not been the case yet because they have generally maintained a relatively good image and social mix even after two decades of transition. (Hegedüs 2012).

After the collapse of the socialist regimes in 1989-1990, a mass privatization and restitution program took place in most transition countries leading to a steep rise in home-ownership (Clapham et al. 1996; Struyk 1996; Lux 2003; Mandic 2010, Hegedüs, 2013b). In the past twenty years, almost every transition country has introduced important changes for the regulation of condominiums. However, the regulatory framework pertaining to the management of multi-unit buildings often remained undeveloped for years into the transition. The poorly regulated privatization was also responsible for disputes concerning land ownership and the property rights of the various facilities attached to condominiums.

As a consequence of privatization and the transformation of property management for multi-unit buildings after the transition, apartment’s owners with different financial and cultural backgrounds and aspirations faced new challenges in how to manage the buildings. This led to a number of
studies focusing on how to enhance cooperation and community-based decision making among owners with regard to maintenance, renovation, and the use of common spaces (Bank et al. 1996; Rabenhorst and Ignatova 2009, Rabenhorst 2012, Hegedüs-Teller 2013). These tasks were unknown during the socialist period and the new owners had to develop the capacity to manage these issues within emerging legal and institutional frameworks. In a few transitional countries some new owners were able to operate home owners’ associations efficiently, but the overall improvement remains rather slow due to ineffective regulations, lack of support or incentives and, in some cases, due to the voluntary nature of such associations (Hegedüs 2012).

1.2 Housing stock in Ukraine

The Ukrainian housing stock counts a total of 19.3 million housing units. This includes 9.3 million apartments divided in 82,000 multi-residential buildings. 70% among them are located in cities and are inhabited by over 80% of Ukraine’s population (Derzhkomstat 2012). The Ukraine housing stock is relatively old: 42% of total residential buildings have been constructed before 1960 and only 7% after 1991. In particular multi-apartment buildings 30-50 years old, characterized by the use of low-cost, poor quality and untested industrially produced materials, are in bad condition due to poor construction quality and lack of maintenance. Enhancing the energy efficiency of the housing stock in Ukraine is urgently required. The estimation of heat losses in these buildings amounts to approximately 50%. Life in these buildings is very unhealthy due to low thermal comfort and to the exposure to ecologically unfriendly and hazardous building materials (GOU 2011, Zapatrina 2010).

In conditions when Ukraine can count only on using the gas of domestic extraction for heating, the priority for the country has become implementation of energy saving projects and, in the first place, decreasing of heat consumption in buildings. Taking into account the limited possibilities of budget support for such projects, a rigorous sustainability assessment with tools such as PETRA with EPC is urgently needed along with an overall assessment of the socio-economic and institutional opportunities and challenges.

In Ukraine, the need to enhance the energy efficiency of buildings is the first priority task and addressed by several on-going project. Although all the projects share the same goal of reducing Ukraine’s energy consumption, there are currently no projects focusing on the development of a methodology which parallel assess the EE of buildings, calculate the investments and prepare the EPC. Moreover, the timing of this project is particularly appropriate because of the Ukraine Parliament recognition of the urgent need of such tools following the adoption of new legislations related to energy savings. The proposed project will contribute to the development of a competitive software market (tools) on preparation of EPC and assessment of investments into increasing of energy efficiency of buildings and will allow the use of the method PETRA in Ukraine, a tool that has already proved its effectiveness in the European area.

There are currently no officially recognized labels for energy efficiency in Ukraine. The country presently only disposing over buildings norms, which have to be followed for the analysis of energy efficiency characteristics. These however are only applied in the project preparation phase of new buildings and for reconstruction of buildings.

2. Methods

The project will enable to introduce in Ukraine the Swiss experience in increasing energy efficiency of public and residential buildings. The timing of this project is particularly appropriate because of necessity to assist the cities in determination of buildings that first require thermo-modernization, and to optimize using of budget funds for this purpose. It is also important that presently the Government of Ukraine is in the process of drafting policies for increasing the energy efficiency of buildings and is looking for relevant methodologies and the preparation of EPC. In the Memorandum between Ukraine and IMF (implementation of which is supported by USAID Municipal Energy Reform), the following tasks were recognized as important: stimulation of population and multi-apartment buildings co-owners unions to buildings energy efficiency and introduction of ESCO contracts. The Ukrainian Parliament recognized those tasks as the first priorities in the Coalition Agreement, adopted on November 21, 2015.
At the same time, the issues of development of methodology of evaluation of buildings energy performance characteristics and cost of their thermos-modernization are not covered by the current projects of international assistance. A dissemination of the Swiss experience among Ukrainian stakeholders is extremely important with the aim of introducing rigorous approaches in this area, in particular, opportunities of practical implementation of the set tasks. Pechersk и Shevchenkovskyi District state administrations in Kiev expressed the interest to practical use of PETRA methodology, by proposing pilot buildings to prepare for them Energy Performance Certificates using this methodology and to conduct wide public discussion of the audit results.

High level of energy resources consumption in the Ukrainian buildings is caused not only by imperfect legal regulation and absence of information on the best practice of implementation of energy efficiency measures in other countries, but also by the absence of convenient and clear understandable methodology of evaluation of energy consumption in residential buildings and by the cost of implementation of measures that will result in essential improvement of energy performance of buildings.

The purpose of the project is the transfer of knowledge of the heat balance calculations and analysis of the building refurbishment thanks to the methodology PETRA. Through this project, new skills and methodologies are being offered. These will be organized, synthesized and adapted to the needs of the Ukrainian partner. In particular, the stages of analysis of improving energy performance in buildings as well as the calculation of the interventions and related costs will be performed and discussed in detail.

The following list gives an overview of the activities, divided in work packages:

2.1 WP0: Background studies
The main activities of the first WP, that consist of literature review, state of the art of research and secondary data collection, already started in the framework of the Government EPC formulation process. The results had been analysed and integrated in the process.
An extensive contextual and policy analysis, with legal framework, and socio-technical challenges closes WP0. This has provided a better understanding of Ukrainian reality and conditions, giving useful information that determined the direction to be taken.

2.2 WP1 Adaptation of the PETRA methodology to the Ukrainian conditions
In this phase took place many meetings with relevant stakeholder, for example the Kick-off meeting with all institutional interested parties and a Round Table Discussion with a selection of Organisation. Objective of the round table was the exchange of experiences, to show how this project fits in the existing other projects and researches.
The Round Table made, in addition to being useful for carrying forward the comparison, provided the opportunity to meet many stakeholders of other projects and to establish new contacts and connections. For example, through the meetings with Union of Housing Owners of Ukraine, Communal Enterprise “Kiev ESCO”, Kiev Energy Agency and Ukraine Association of Energy Auditors, the selection criteria may have been established, both for the workshop participants and for the sample of buildings to conduce the energy efficiency assessment.
In addition to these two important meetings, those that have taken place with EBRD, GIZ and SCO, permitted to establish further contacts with relevant stakeholder in the International Cooperation. As first result of the discussion, the present project team received an invitation on an inauguration of a renovated Kindergarten in Zhytomyr. Furthermore, EBRD and GIZ showed us interest to invite more energy auditor from other cities to the PETRA teaching workshop. Effectively a group of 7/8 external energy Auditor participated to the learning.

Comparative analysis of PETRA with other existing methodologies, with a comprehensible demonstration of efficiency and applicability of Petra methodology.
The deliverable of this phase is condensed in a diagram (Figure 1) which contains a visual comparison that shows the field of application of six different Tools (Petra, the Swiss official EPC-GEAK, and 4 tools used in Ukraine).
This graphic confrontation clearly shows the additional value of the PETRA Tool as resumed here:
• Web-based instrument
• Adapted to Ukraine condition
• Contains analysis of actual situation
• Contains energy balance of buildings
• Contains actual EPC
• Contains more than three renovation scenarios (with or without thermo-modernisation), each with EPC forecast
• Contains Data Bank of buildings including Safety and Heritage.

Integration of data related to Ukrainian standards and assessment.
To realize this phase, the following actions were carried out. Thanks to a DUMP of Petra, that creates the website of the PETRA-Ukraine, the result of the comparison between SIA 380/1 and Annex 3.1; the Algorithm for EPC; the climatic data of Kiev, the different coefficients and the Ukrainian costs, among other, could be integrated in the Tool. After analysis of the data collection and the implementation of the PETRA-Ukraine, the assessment of one sample building, a multifamily house, has been conducted. The results of this first attempt are encouraging because the difference between PETRA and the Ukrainian draft law on energy efficiency was only 8% as shown in the figure 2 below.

Figure 1  Visual restitution of the comparison

Figure 2  Print screen of Petra Ukraine
2.3 WP2: Training by Swiss Expert.

Training Workshop to enable 12 Ukrainian instructors to use the methodology.

This phase, which involves the training of Ukrainian experts, has begun with the presentation of the entire project stages, before moving to the theoretical part containing information on Swiss regulations, which are the basis of the calculation tool, compared with the European regulations in part into force in Ukraine. At the end of this presentation, there was a general discussion on this comparison. During the afternoon the theoretical introduction into the PETRA tool, including a small and simple exercise in order to familiarize with the methodology, was the most significant part.

The second day was devoted to the inspection of four buildings, because this is an essential part of the methodology. The purpose of the visit was to carry out an examination following a default checklist, performing an analysis of the degradation of the construction and plant elements. The last part of the teaching was dedicated to the work with the on-line tool, following the checklist of the previous day. Data entry begins with the modeling of the building, by calculating all dimensional coefficients, by entering the degradation codes (Figure 3) and energy data of each of them and subsequently each trainee had to define different refurbishment scenarios. In each of those scenarios, the tool calculates the payback time and the forecast of the energy certificate. This part, which corresponds to one of the strength of PETRA, was much appreciated.

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Figure 3 Resume of the diagnosis with degradation codes concerning Roofs, Façades and Windows of the Kindergarten #104, 58 Polkova str.

Case studies of residential or public buildings.

In accordance to the Ukrainian stakeholder, at the end of the training workshop, twelve buildings have been selected (2 residential buildings and 10 School / Kindergarten) and to each of the twelve participants one of these stable has been assigned. Following the learned methodology, each Trainee started with the analysis until the End of June.
2.4 WP3: Result dissemination

During the following months, to assure the dissemination of the results those steps have planned:

• An integrated, comparative analysis.
• Final meeting, publications, seminars, workshops and a conference.
• Choice of energy auditors to be trained for the replication.
• Promotion of the tool of a voluntary basis if legal conditions will not be implemented.

3. Results

The results reached at the moment, are listed here:

• Adaptation of Swiss PETRA methodology to Ukrainian conditions;
• Training of Ukrainian instructors on the use of the PETRA methodology in Ukraine with a formal examination at the end of the course and the issuance of certificates;
• Application of the adapted PETRA tool in assessing a representative sample of buildings in Kiev.

In this paper, have been displayed few extracts from a report carried out at a Kindergarten, as an example of all the work done so far to the end of WP2, while the WP3 should be initiated soon. Figure 3, 4 and 5 have been extracted from a reports, to show the degradation codes fixed during the inspection, the parameters that describes one refurbishment scenario and a table with the comparison of the different scenario with the actual situation.
The results are in the moment only partial and to start the comparative analysis between the twelve reports, each Trainee has now to improve his own work.

After this step, those other results can be assured in the next future:

- To enable Ukrainian instructors to train energy efficiency specialists and maintain and/or adapt the tool to the changing framework conditions;
- To enable Ukrainian specialists to maintain and/or adapt the tool to the changing framework conditions;
- Wide dissemination of the results to the local governments and public through publications, seminars, workshops and a conference;
- To raise awareness among key stakeholders including the private sector about the potential and benefits of energy saving.

4. Discussion

The project enable Ukraine stakeholders to conduct rigorous assessments of energy efficiency characteristics of buildings, and overall refurbishment requirements, and the development of related renovation strategies through training and through the dissemination of a contextually adapted version of a methodology and software developed and currently used in Switzerland. The expected result is a higher comfort of life of the Ukrainian citizens, in particular, low-income families, by decreasing their expenditures for heating’s energy resources in conditions of considerable increasing of tariffs for communal services, by improving the environment and by decreasing negative influence of old construction materials on people. The Government and the citizens of Ukraine will be able to meet their global commitment to reduce CO2 emissions’ and to re-direct budget funds that are now used to cover energy consumption, to other potentially important tasks. It will further decrease the energy dependence of Ukraine from importation, thus contribute to its sustainable economic development.

The project provides a cost-effective strategy to support the implementation of Ukraine’s new law on energy efficiency in public and residential building. As soon as the law will be adopted, public authorities will start preparing energy performance certificates for buildings and calculate the necessary funds to increase their energy efficiency. Results after application of the methodology, inclusive refurbishment, will be implemented in sample buildings in Kiev within a year after the adaptation of the PETRA tool.

The tariffs for communal services has grown in the last two years and the planned further increasing in the nearest future in accordance with Ukraine’s obligations to IMF. In this way, the consumption reduction is becoming economically efficient for homeowners and they are ready even now to invest in the EE. In such conditions, population and market subjects will extremely demand EPC and the related investments calculation will permit them an easier access to financing. The Ukrainian Union of Housing Owners is ready to promote the use of the tool in the whole country.

According to the official policy, the homeowners and a part from the state funds will cover a part of the refurbishment investments required to enhance the energy efficiency of residential buildings. The return of the investment has been determined in WP1, and was expected to be quick due to the poor conditions of the constructions. This was actually confirmed, for example by mentioning the payback time of the scenario 1 for the Kindergarten #104 (picture 5), which is 4.7 years.

The project results will enable local governments, the Association “Energy Efficient Cities of Ukraine” and the Union of Housing Owners of Ukraine to conduct energy efficiency assessments. These entities will thus disseminate the PETRA tool and related knowledge to other relevant stakeholders, including the private sector. The Ukrainian Association of Energy Auditors in the Housing and Communal Sector and the Institute for Environment and Energy Conservation will apply this methodology and develop it further by taking into account the specific conditions of Ukraine. It needs to be underlined that the private sector in Ukraine has a particularly important role in the implementation of projects aiming at enhancing energy efficiency and in the development of related methodologies. This is because the state can create the framework conditions and some specific incentives, but most of the effective work and the investments are to
be searched in the private sector. Information exchange with private sector representatives will also be possible within the framework of the UNECE Housing Forum, which counts on the participation of a tangible number of stakeholders working in the domain of energy efficient housing and refurbishments.

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![Figure 5: Scenario comparison with Payback time of scenario 1 for the Kindergarten #104, 58 Polkova str.](image)

5. Perspectives

The project implementation will allow the population of Ukraine and the decision makers at the state and local level to understand which amount of funds is required to reduce essentially energy consumption of buildings and when the projects on EPC increasing could be recouped. Firstly, this will stimulate and motivate the population that has opportunities to invest in increasing of energy performance of their buildings to start implementation of similar projects. Secondly, the state will be able to evaluate the amount of funds in the state budget that shall be allocated for partial financing of these measures by poor population. The evaluation of energy efficiency indicators of buildings using PETRA, will allow evaluating the level of energy savings that could be achieved in Ukraine in case of conduction of thermo-modernization of buildings. It will allow also planning scopes of co-financing of these projects from the state that is necessary to fulfil Ukraine’s obligations under the Agreement on joining the Energy Union, Association Agreement with EU, and Memorandum of Ukraine with IMF.

Possible added values and commodities of the project are:

- increasing of employment of the population through development of small business in field of energy efficiency;
- decreasing of fee for the consumed communal services and possibility to use saved money for social initiatives;
- decreasing of level of illness among children and poor population;
- decreasing of quantity of accidents because of using electric and gas ovens for heating.

The training component of the project will raise professional energy auditors’ and academics’ (faculty and graduate students) competence in conducting refurbishment assessments with special reference to energy efficiency. This will be of pivotal importance to the implementation of Ukraine’s energy efficient policy. The relevance and replication of the project is ensured by the fact that the request for this projects comes from key stakeholders working in close cooperation with the Government of Ukraine and local authorities.
The project will further:

- Enable a large number of Ukrainian Energy Auditors to carry out PETRA assessment/EPC and to determine institution that will prepare corresponding specialists at the permanent basis (start with 15, every year 25 new auditors);
- Make recommendations to the Government of Ukraine with regard to the introduction of a new methodology for assessing the energy efficiency characteristics of buildings; to prove their recommendations by concrete figures received as a result of inspection of buildings;
- Enable the refurbishment of representative sample of buildings in Kiev based on the results of the PETRA analysis (1-2 buildings carried out from the initial selection – results of this refurbishment will be published from the Ukrainian partners, not in this project);
- Allow to monitor the achieved energy efficiency results for research and policy advocacy purposes in leading scientific institutions of Ukraine;
- Raise awareness among institutes and actors involved in the development and implementation of energy efficiency policies in Ukraine on sustainable energy management strategies in all regions of Ukraine;
- Create the framework conditions for a critical reflection on the relevance, effectiveness, and replicability of PETRA and EPC in the Eastern European context.

Annexe

Literature/references


[12] SIA 380/1:2009. "Thermische Energie im Hochbau" (Swiss Norm 520 380/1)

