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Customer Satisfaction Survey of Implemented Energy Efficiency Measures in Public Buildings in Kosovo

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Abstract: ***This paper contains final results of Customer Satisfaction Survey (CSS) of the both part of studies, phase "before" and "after" implementation of EE measures in public buildings in Kosovo realized during winters 2015/2016 and 2017/2018.For this detailed study of the customer satisfaction assessment, the authors has selected batch of 5 characteristic buildings from the group of 70 public buildings with 165 respondents to identify and measure the level of end users satisfaction, the perception of indoor air and thermal comfort, the awareness on the EE measures, and the additional benefits of EE upgrades (eg. reductions of sick leave days, increasing productivity, increasing budget for other priorities, etc.). During the investigations authors has reviewed the Indicators of achievement, following a careful assessment of their feasibility, together with a proposal for their review/amendment based on findings of the actual conditions assessed on the field during both phases of the study and final results.***

Keywords: Customer satisfaction survey, EE measures, Public buildings, NPI

1. Introduction

The WB funded projects of implementation of Energy Efficiency Measures in public buildings in Kosovo since 2012 has involved the energy efficient refurbishment of public buildings in Kosovo (administrative buildings, schools and hospitals). The purpose of this investment was to encourage more effective use of energy across Kosovo with the major goal to implement energy efficiency improvement in public buildings and the verification of the energy cost savings as well as CO2 emission reductions achieved by these energy efficiency measures.

The main purpose of this field study is to present the level of customers satisfaction for selected batch of 5 buildings, with the main aspects set in the objectives section for each of facility separately, before and comparison after the retrofitting and summary report summarizing findings of the occupants satisfaction disaggregated by service (education, health), by gender as well as summarizing common benefits perceived by beneficiaries.

Generally, administrative buildings, hospitals and schools are perceived as the most appropriate types of public buildings where energy efficiency measures and the achievement of comfort and quality environment can be analyzed. This is justified by the fact that these measures contribute to increasing the productivity and sustainability of employees, patients, students and moreover ensuring a healthy environment and comfort for work, for health and education purposes. Unfortunately, in practice, public buildings face the same or even more intense problems of energy performance of buildings and comfort problems compared to other buildings.

Therefore, authors, in close cooperation with the WB PIU members has carefully analyzed types of buildings and selected batch of five buildings composed by university buildings, hospital clinics and administrative buildings as public building examples applying the same methodology in realizing of survey in phases "before" and "after" implementation of EE measures.

2. Methodology and project activities

The study was carefully prepared because it has own distinctiveness as field study. In the final phase, authors have applied same methodology in realizing of survey as in phase before and again, prior starting the final quantitative study has prepared a tentative list of numbers of participants selected in categories as students and teachers separately, patients and nurses, doctors separately and building employees. Authors have decided to use same number of respondents to keep the study consistency. Participants were selected randomly, taking into consideration all relevant parameters (gender, age and occupant's status) as follows:

- For university buildings to be selected 30 persons grouped in 20 students, 5 professors and 5 employees and other staff.
- For hospital clinics were selected 35 persons grouped in 15 patients, 5 doctors, 5 nurses and 5 visitors and technical staff
- For administrative buildings were selected 30-40 persons grouped in 20-30 employees, 5 visitors and 5 from technical staff

Interviewing timing was respected to be as agreed in former meetings with beneficiaries based on their working schedule and daily activities. In hospital buildings the survey was conducted during peak hours when there were patients and visitors in the building always avoiding morning medical visits and doctor's consultations, respectively (9:00 to 12:00

AM). For faculty buildings the timing was chosen at their convenience during lectures, in the morning and afternoon. As for administrative buildings was concluded that the timing had to be during working hours (8:00 to 16:00).

Prior starting the distribution of the questionnaires, participants were informed about purpose of the survey, instructed on filling up the questionnaires and the expected answers to be as much as possible realistic and accurate, choosing the most appropriate answer.

Social monitoring data from the final quantitative part of study are collected to establish the impact of energy efficiency investments on end-user's behavior, awareness, and level of satisfaction. Baseline data are collected before the retrofitting works. Satisfaction information from end-users was used to identify and solve eventual unforeseen issues that arose after implementation.

Moreover, authors have in details instructed participants for performing of distribution and collection of questionnaires. All data were stored similar to the prior surveys, in separate data base for further analysis, discussions, visualizations and presentations of results.

During the course of the study, regular social monitoring surveys were conducted. In total, 165 end-users, identical number as in survey before implementation of EE measures, (such as students, professors, administrative and technical staff, patients, and medical staff) were interviewed in 5 institutions before and after the retrofitting works. Again, the final survey methodology, similar to the phase before, utilized quantitative (survey questionnaires for research in the institutions with the institutions' users) and qualitative (in- depth interviews with decision makers in relevant institutions and local self-governments) approaches to systematically measure the social impact of project activities. In particular, the survey was focused on the following parameters:

- Levelofindoorcomfortandend-user'ssatisfactionwithheating,acoustics,andlighting;
- Level of awareness of energy efficiency works, their benefits, and their importance in regard to education;
- Changes in behavioral patterns with respect to application of energy efficiency measures at home and
- Level of recognition of the project's contribution to the increasing of comfort, productivity and end-user's awareness on implemented EE measures.

Authors have organized focus group discussions on the customer satisfaction with building's representatives to fine tune results from the quantitative study. Focus groups are established for each building separately, which means one focus group for each building based on gender and occupancy. Focus groups were mixed.

3. Qualitative and Quantitative study implementation

Prior to starting the final qualitative and quantitative study, authors have reviewed collected specified certain information for each building separately. These information includes general data about building, working schedule, number of occupants, structure of occupants (i.e. employees and clients) and building operation (seasons). For each building was prepared specific Study Plan which includes selection of the rooms, offices, patient rooms, amphitheaters etc. where the study was planned to be conducted. It means that selected students f.ex. will be interviewed in prior selected teaching rooms and offices, amphitheaters where the lectures are ongoing, patients were interviewed in their rooms, visitors and clients randomly in halls and corridors, employees in their offices, etc.

On agreed days and times, professional supporting teams were sent to the selected buildings to perform quantitative and qualitative study in accordance with the approved methodology. Certain required numbers of questionnaires divided in separate folders for thermal, social and qualitative survey were prepared.

There were prepared Tables of data of the number of total project beneficiaries and co-benefits during implementation, disaggregated by gender for both phases. Having in mind that in the Hospital building are located two different Clinics, authors have decided to organize separate investigation dividing number of the respondents in two groups with minimum of 15 selected persons grouped 7-8 patients, 3-5 doctors, 3-5 nurses and other technical staffs depending on organization chart. In hospital buildings the survey was conducted during peak hours when we had patients and visitors in the building always avoiding morning medical visits and doctor's consultations.

With both Directors of the Clinics, Dermatology and Pulmology, authors agreed for selected reference room and potential respondent and occupants with required professional, gender and age profiles. Some of patients were interviewed in their rooms to have as realistic as much answers.

In collaboration with the Institution Directors, from the separate meetings, for each Clinic were established Focus Groups representing all profiles of occupants based on profession, age and gender. With these Focus Groups were organized and held focus group discussions on the customer satisfaction, to fine tune results from the quantitative study.

For qualitative study (in-depth interviews with decision makers in relevant institutions and local self-governments), authors have planned to interview except internal personnel, also Director of UCCK, Technical Director, Director of Maintenances and two of chiefs of Departments of Pulmology and

Dermatology. Final list of persons to be interviewed was fine-tuned with the responsible in both clinics. There were chosen six persons from above mentioned categories. During round table discussions and individual interviews, different issues are raised, from reviewing of up to date investments on implementation of Energy Efficiency till the expectations of beneficiaries regarding the

improvement of comfort level after implementation of planned EE measures. Moreover, there were discussed users' control of heat consumption empowered hospital and municipalities with information to understand the benefits of tracking and monitoring energy efficiency consumption, possibilities to allow public officials to gain practical experience through managing energy efficiency investments in selected buildings and also helped to reinforce public approval to foster broader replication. Authors found very productive these discussions to gain experience for finalization of final model of questionnaires. The only serious remarks are identified during discussions with ASK management because of the volume of implemented works. In this building only the heating system is refurbished while building envelope reconstruction is deducted from the initial investments because of the status of the building, as cultural heritage under protection.

During investigations performed in Technical Faculties Building were found some specifics. In the same building are located three different institutions, Faculty of Civil Engineering and Architecture, Faculty of Mechanical Engineering and Faculty of Electrical Engineering. Based on beneficiaries' requirements investigations are divided in all three different micro location using for interviews their own staff and employees and students as well.

Interviews are performed in professor's offices, teaching rooms, amphitheaters and faculty hall. Same to above mentioned procedure, Focus Groups members are selected from all three institutions while members of qualitative study group for In-depth discussions were compiled from deans and vice deans.

Focus group discussions on the customer satisfaction were organized to fine tune results from the quantitative study, interviews with representatives of the institution authorities and with people from the respective administrative line required to prepare a report featuring the level of customers' satisfaction with the main aspects set in the objectives section for each facility for "after" implementation phase. In initial meeting were clarified all raised questions, were fine-tuned questionnaires and agreed number and structure of Focus Group and Qualitative Study.

4. Results and Discussions

4.1 Statistical Analysis

After completion of interviewing procedure, the questionnaires were collected and completed in separate files for separate fields and each selected building. General information about building, buildings location, reference room and outdoor temperature were filled on questionnaires by surveyor.

Knowing that interviews were anonym authors have used same numbering for both thermal and social survey. The number of respondents intentionally remained the same to be replicated as identical as possible. Moreover, each of general information, as gender, age and profession as well thermal survey and awareness answers on questions were labeled with certain number for easier data processing. For this purpose, were designed tables of legends which clearly define each category. Attached to this report are samples of Legend sheets.

All answers separated by respondent, respondents' age, gender, profession and institution where than collected in separate tables for further statistical analyses and compared with the results from the phase "before" measures.

It is important to mention that authors have decided to use the Net Positive Index (NPI) analyses which are the difference between combined Top Box and combined Bottom Box responses. Based onexperiences from previous studies, customers who select a 5 response (Top Box) for thermal and awareness satisfaction questions have had some experience or interaction that has motivated a more defined, positive perception. These customers are much more likely to demonstrate their reaction on impact of thermal environment conditions and energy efficiency investments on end-user's behavior and awareness, due to the level of their satisfaction.

Respondents who select the 4 response may not be dissatisfied, but neither are they likely to demonstrate satisfaction, while respondents who select a response between 3, 2 or 1 (Bottom Box) frequently have had some perception or experience that has driven their evaluation to a lower level.

In short, an NPI above 100 means that more respondents selected a Top Box response than selected a Bottom Box response, while an NPI below 100 means the opposite – there were more Bottom Box responses than Top Box responses. For NPI analysis are used all collected data used for prior standard statistical analysis from questionnaires, thermal environment survey and end users' behavior and awareness.

By focusing on the net difference between the most satisfied and least satisfied customers, the NPI shows in one number the entire range of responses to each question. Adding 100, eliminates negative NPI's and helps to eliminate confusion, as well as facilitating comparisons where scales may differ.

The equation was: [5 ratings – (3 ratings + 2 ratings + 1 ratings)] + 100 = NPI.

Authors have used their already designed own unique range of ratings from 5 as excellent till 1 as unacceptable based on the specifics of each question. For example, in standard statistical analyses for Thermal Environment Survey authors have used the Predicted Mean Vote (PMV) which refers to a thermal scale that runs from Cold (-3) to Hot (+3), originally developed by Fanger and later adopted as an ISO standard. The recommended acceptable PMV range for thermal comfort from ASHRAE 55 is between -0.5 and +0.5 for surveyed spaces in all selected buildings. For the purpose of using NPI equation authors have used rating 5 for neutral (0) in

thermal scale, while for bottom level, 3 for warm (2), 2 for cool (-2) and 1 for cold (-3) and hot (3) as is presented in following table:

Neutral	Slightly warm	Slightly Cool	Warm	Cool	Cold
5	4		3	2	1

In similar way is acted in evaluation of ratings for other parameters during the thermal Environment Survey, noise level and lighting level as for all parameters impacted of energy efficiency investments on end-user's behavior and awareness.

4.2 Quantitative Study

Having in mind differences between analyzed buildings in construction, use of buildings, character of institutions and discrepancies between occupant's professions, it was expected to have some different findings comparing with the results from phase before implementation of EE measures. Therefore, authors have decided to make Statistical Analyses for all five buildings as a compilation of data from individual analyses for this final phase.

Results from the Customers Satisfaction survey for Thermal environment survey for all five Buildings shows, that majority of the 165 respondents are female around 57%, around 44% are middle age, between41-50 years old.

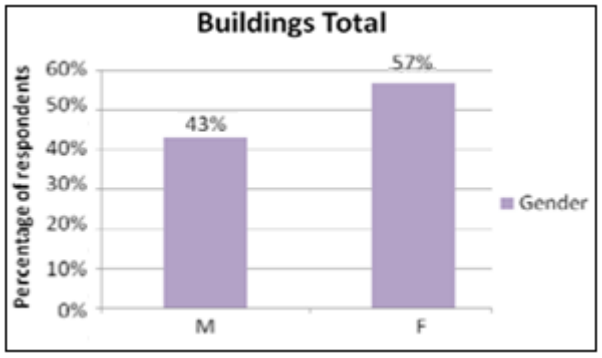

Figure 1: Diagrams of Percentage of respondents divided per gender for batch of 5buildings

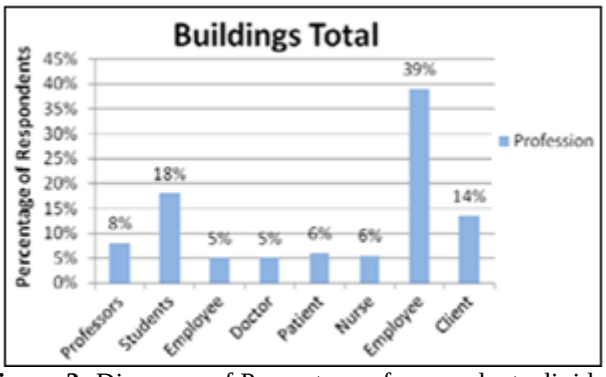

Figure 2: Diagrams of Percentage of respondents divided by profession for batch of 5 buildings

Most of interviewed were employees (professors, doctors, nurses and other employees) around 81%. Activity level is related to the occupant's structure so it is mostly sedentary in total 67%.

Results of thermal environment survey parameters for all buildings, shows that both male and respondents' percept general thermal comfort as very acceptable, 31% of males and 35% of females as neutral and around half both males and females as slightly warm meaning very comfortable as shown in Fig 2. Moreover, more than 87% of respondents were not annoyed and slightly annoyed with the noise level and around 58% of respondents are satisfied and slightly satisfied with the level of lighting.

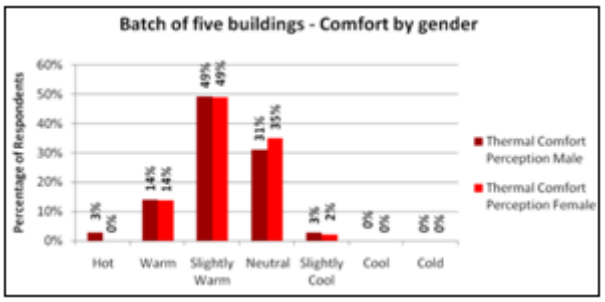

Figure 3: Percentage of satisfaction with the comfort parameters for all five buildings disaggregated by gender.

Social monitoring survey results for the all five buildings, subject to phase after implementation of EE measures, shows significant increase of awareness of the works undertaken by the project up to 89% as very aware and somewhat aware that comparing with the results from pre phase of only one third of respondents were aware and 40% somewhat aware of the works undertaken in the all five buildings, is absolutely improvement. Three quarter of respondents were very aware and somewhat aware of benefits of implementing EE measures, and same percentage has indicated their readiness to invest in EE measures in own household and were very aware and somewhat aware on importance of education on energy efficiency. Results and answers related to the awareness on renewable energy sources and climate change shows very high percentage of respondents, around 83% which are very aware ore somewhat aware on these topics.

4.2.1 NPI Values

As it is mentioned above, authors have used Net Positive Index (NPI) criteria as a parallel tool for evaluation of end users' response on questions, as the difference between combined Top Box and combined Bottom Box responses. As it is explained above, customers who select a 5 response (Top Box) for thermal and awareness satisfaction questions have had some experience or interaction that has motivated a more defined, positive perception. These customers are much more likely to demonstrate their reaction on impact of thermal environment conditions and energy efficiency investments on end- users' behavior and awareness, due to the level of their satisfaction.

Comparing with the results before implementation of EE measures authors found significant improvement in evaluation of noise level with NPI= 143 much higher than benchmark and lighting level with NPI=111 as value close to the benchmark. But, for the total batch of five buildings results of NPI values for Buildings Survey on Impact of EE are reduced going as it is presented in Figure below.

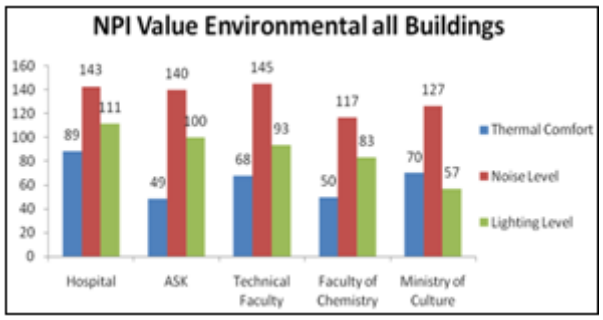

Figure 4: NPI Values for comfort parameters for all buildings

4.3 Qualitative Study

Based on procedure steps set in Study Methodology, even it was planned bit different; authors have decided to call In-depth interviews and round table discussion individually with representatives of the local authorities and with people from the respective line Ministry to clarify conclusions and results from the quantitative part of the Customers Satisfaction Survey after implementation of EE measures.

Decision makers in relevant institutions and local self-governments were interviewed and requested to answer on qualitative questionnaire respectively questions on how they recognize the project's contribution to the increasing of comfort, productivity and end-user's awareness on implemented EE measures.

During these interviews are highlighted users' control of heat consumption empowered hospital, universities and public buildings administrators and municipalities with information to understand the benefits of tracking and monitoring energy efficiency consumption. Some identified discrepancies in perception of thermal comfort in Agency of Statistics of Kosovo (ASK) taking into account the reduced implemented measures as investments on building envelope and are discussed to find argumentation for future proposals for eventual technical solutions for some next phase of implementation of retrofitting works.

Moreover, during the in-depth interviews, authors have investigated how much this project has allowed public officials to gain practical experience through managing energy efficiency investments in selected buildings between two phases of implementation of retrofitting works and also helped reinforce public approval to foster broader replication.

At the ministry level as well with PIU, was discussed what kind of professional experience is expected to be gained in managing and implementing complex supply- side energy efficiency projects.

Results of in-depth interviews with decision makers and members of focus groups are used for additional analyses and evaluation of NPI indexes for specific surveyed buildings and for whole batch of five buildings. The only question for respondents in this phase was how much this project has allowed public officials to gain practical experience through managing energy efficiency investments in selected buildings and also helped reinforce public approval to foster broader replication.

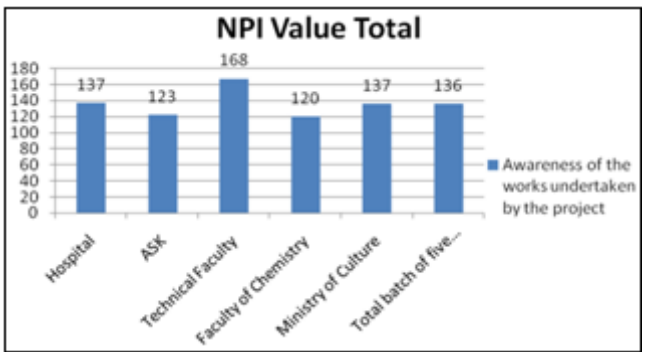

Figure 5: NPI Values from qualitative study for all buildings

The value of NPI=137 illustrates somehow that interviewed officials has openly approved all initiatives in implementation of energy efficiency measures and has evaluated quiet positively gaining of practical experience through managing energy efficiency investments in selected buildings.

5. Conclusions

Customer Satisfaction surveys were conducted in 5 selected buildings after implementation of the retrofitting works to systematically measure the social impact of project activities as baseline for comparing with the phase before implementation of the Energy Efficiency measures. The survey methodology utilized quantitative (survey questionnaires for research in the institutions) and qualitative (in- depth interviews with decision makers in relevant institutions and local managing staff) approaches to systematically measure the social impact of project activities.

In total 165 end-users (such as students, professors, administrative and technical staff, patients, and medical staff) were interviewed in 5 institutions after the retrofitting works Results from the Customers Satisfaction survey for Thermal environment survey for all five public Buildings shows, that majority of the 165 respondents were female around 55%, around 25% was middle age, between 41-50 years old and most of interviewed were employees (professors, doctors, nurses and other employees) . Activity level is related to the occupant's structure so it is mostly sedentary in total 66%.

The survey findings revealed very small differences between male and female respondents in their perceptions of thermal indoor comfort.

Results of thermal environment survey parameters for all buildings, shows that both male and respondents percept general thermal comfort very similar, varying from warm to neutral, with total of 49% males as slightly warm and 35% of females perceived as neutral, respectively mostly comfortable and only 6% of males and females feeling slightly uncomfortable, while 14% of males and females percept the thermal comfort as warm. Moreover, more than three of forth of respondents were not annoyed and slightly annoyed with the noise level and around 35% of

respondents are neutral and 30% slightly satisfied with the level of lighting.

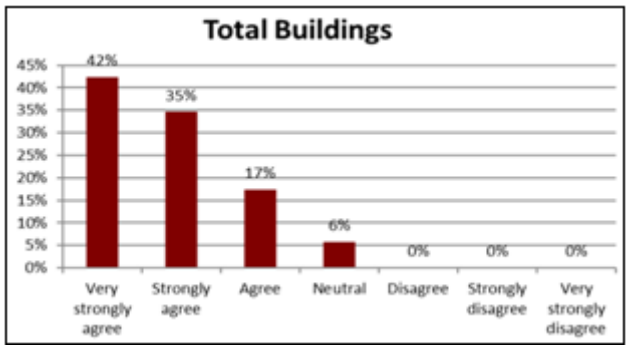

Figure 6: Percentage of respondent's awareness on impact of energy efficiency measures and projects contribution for all five buildings

The awareness of energy efficiency measures and their associated benefits were surveyed as part of general Customer Satisfaction Survey before implementation of EE measure as a baseline to building are compared with the post implementation phase realized during 2016/2017. More than 89% of end-users confirmed they were very aware and somewhat aware of the works undertaken by the project and were significantly inspired by the energy efficiency works to be implemented in the public buildings, and for the application of energy efficiency measures at own homes. Almost two third of respondents were aware of benefits of implementing energy efficiency measures and four out of five respondents (83 percent) interviewed mentioned that they will learn about energy savings, renewable energy sources, and climate change during implementation of the project.

Almost unanimous satisfaction with the expected results of the works and in future achieved benefits was recorded during in-depth interviews with decision makers in public buildings and local self-governments, such as faculty deans and hospital directors and managerial staff. This is confirmed also with high level of NPI values for qualitative study. Some perceived discrepancies in thermal comfort of ASK building are discussed with focus group members and decision makers during in-depth round table discussions trying to find logical explanation which will impact improvements of technical solutions during future retrofitting works and implementation of energy efficiency measures.

More than 77% of respondents from five Focus Groups highly agree with project contribution on increasing comfort, productivity and awareness on implemented measures. Results are presented in Fig.6.

Social monitoring before implementation of the Energy Efficiency measures has proven to be an effective tool for capturing the impact of energy efficiency measures in terms of identification of comfort levels, awareness, and consumer satisfaction. Such information has proven to be useful for establishing of the baseline for improving the project design and dissemination strategy for greater impact of EE measure. End-users confirmed they were inspired by the energy efficiency works implemented in the public buildings, and the application of energy efficiency measures at home.

All above conclusions fit very well with the identified NPI values for different questions and specific buildings.

References

[1] Muhaxheri, K., Nepravishta, F., Alushaj, R., "Evaluation of implemented energy efficiency measures in public buildings in Kosovo", International Journal of Advanced Research in Engineering and Technology, Volume 9, issue 4, July-August 2018, pp.333-342
[2] Abel, E., and Elmroth,A., " Building and Energy" Formas, 2007
[3] EU Commission "Technical Guidance-Financing of Energy Renovation of Buildings"-Final Report,2014
[4] National Building Energy Efficiency Study for Kosovo, Final Report,2013
[5] EU Commission, DG Energy "Energy performance certificates in buildings" Final Report, 2013
[6] Implementation of Energy Efficiency Measures (EEM) in schools and hospitals in Kosovo, Final Report,2016
[7] EU Commission, DG Energy, A Guide to the Energy Efficiency Directive,2013
[8] BS Department for Education "Guidelines on ventilation, thermal comfort and indoor air quality in schools" Building Bulletin 101, June 2016
[9] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the Energy Performance of Buildings (recast)
[10] Directive 2002/91/EC of the European parliament and of the council of 16 December 2002 on the energy performance of buildings
[11] Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings
[12] European Commission "Schools Indoor Pollution &Health Observatory Network in Europe", Final Report,2014
[13] EN 13829, Thermal Performance of Buildings, ISO Energy9972:1996,modified
[14] RETScreen® Software. Online User Manual, Minister of Natural Resources, Canada 2005
[15] Daisey,J.M et al." Indoor air quality, ventilation and health symptoms in schools", Indoor Environment Department, Lawrence Berkeley National Laboratory, 2003
[16] Harvey, D.L.D. " Energy Efficiency and the Demand for Energy Services", Earth scan, Washington DC,2010
[17] Boermans,T. and Petersdorff, C. " U-values for better Energy Performance of Buildings", Report established by Ecofys for EURIMA, 2007
[18] Bayer,C.W., Crow, S.A., Fischer, J., "Causes of Indoor Air Quality Problems in Schools", 2000
[19] Torcellini, P.A. and Crawley, D.B "Understanding zero-energy buildings", ASHRAE Journal, vol.48, pp62-69, 2006
[20] Johnsen,K., " Energy Conservation in the Built

Environment"; Session 4 – Design for Low Consumption.
[21] EPEC, "Guidance on Energy Efficiency in Public Buildings",2010 Ramboll and IEEP,:" Energy efficiency in public and residential buildings" Work Package 8, EU 20