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An Innovative Social Model to Monitor Usage and Energy Performance of Public Real Estate based on ICT Applications

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Abstract

After a review of some critical issues about usage and energy efficiency in public buildings, the paper describes Planergy™, a service model which supports public administrations to monitor their buildings. The service, which is distributed through a web platform www.Planergy.it, represents an interesting social innovation since it directly involves workers and building users and since its results can be diffused as Open Data Sets. Its results can assist local administrators in developing a substantiated institutional communication and in adopting a sustainability reporting that takes into account both environmental and social consequences of their policies.

Through the support of empirical data collected from its buildings, the administration can encourage specialists and firms in developing effective project proposals and it can motivate employees and the public towards energy efficiency good practices. In this way, an administration council can become a source of inspiration and good example to promote sustainable energy within its municipal area.

Some preliminary operational results are outlined which are taken from the adoption of Planergy in a small municipality in the center Italy.

***Keywords**: public buildings, sustainability report, energy efficiency, SEAP, open data, users behavior, awareness, energy savings accounting, energy management service.*

1 INTRODUCTION

Buildings, as the recipients of 40% of final energy consumption, play a central role in the energy-saving policy of the European Union: their efficient use depends not only on their architecture and quality but also on the behavior of citizens and users and on of their sensitivity to the problem.

The European[1] and national legislations assign to public bodies the task of stimulating the social communities towards the improvement of buildings energy efficiency. A first way to achieve this task is to implement exemplar interventions on their own buildings and to disseminate the achieved results, in order to raise awareness and to motivate the public.

This objective can be achieved through the experimentation of patterns of behavior and of best practices to improve quality and to boost the efficiency of the entire real estate industry, with a positive influence also on the private sector. The service herein described can be seen as one of such models of social value which is largely based on specific ICT applications.

[1] *EU Directive 2012/27/UE Art. 16.*

2 PUBLIC BUILDINGS AND ENERGY EFFICIENCY

The energy efficiency improvement and the usage of public buildings [1] present some peculiar characteristics which are briefly summarized below.
Each property is inextricably linked to land, at construction epoch, to the culture of its inhabitants, to social fabric, the users behavior and to climate. All these factors influence the selection of specific technological solutions and the unique structural and functional features of the building, so that, to improve buildings performance, it is necessary to know deeply their context.
The management of public buildings may be often characterized by a poor knowledge of their technical facilities and of their operating and maintenance costs, thus resulting in the need for an accurate reconnaissance. This initial activity should produce an effective information system to be used as an essential tool for a correct property management.
On the other hand, the availability of periodic observations and measurements, concerning the building behavior and its energy consumption, is an essential knowledge base to define an effective program of interventions. Such a program should be conceived in the frame of real estate management and it should account for the scheduled long-term maintenance of the buildings.
To be sure that the expected energy savings will be gradually accrued over the years, the EE interventions must be well designed and executed from the beginning. Furthermore, the buildings should be subject to an assiduous maintenance and to a proper property management.
Users' behavior can highly affect the actual energy savings levels in buildings. Since this factor can even cause the collapse of major energy efficiency projects, awareness campaigns and rules of good behavior become indispensable tools to reduce this risk.
Close coordination among users behavior, owner's initiatives and actions of the property manager is a prerequisite for obtaining a loan that is guaranteed not only by the value of the property but mainly by the volume of the savings expected over the years .
Compared with a fixed budget and given the high variability in intervention costs induced by the specificity of each property, the public entity should intervene only on those buildings that show the greatest potential for savings. In order to adopt such a decision strategy, a public administration should then:

- reconstruct a comprehensive archive on public properties and on their energy behavior;
- Implement and active organizational and operational procedures necessary to maintain updated information framework;
- define, pursue and monitor the objectives of improving energy efficiency, according to the SMART approach (Specific, Measurable, Achievable, Realistic, Time-bound).

Given the current state of public finances, marked by a lack of own resources, funding for measures to improve the energy efficiency of buildings is primarily based on the financial soundness of their owners.

However, the adoption of models which constantly monitor the achieved energy savings can highly support alternative financing forms based on the measurements of actual results.

3 PLANERGY™ AS A SERVICE

Within the above outlined framework, Planergy ™ has been developed as a service aimed primarily at small and medium sized public bodies such as municipalities, mountain communities, associations of municipalities, provinces. However, larger public and private institutions can also fruitfully use it.

Provided through a web platform (www.Planergy.it), the service represents an operational instrument by which a public body can effectively promote examples of energy sustainability within the territory under its jurisdiction. It is, therefore, an interesting tool for social innovation in agreement with the already-mentioned EU objectives in terms of transparency and energy saving.

A qualifying aspect of the service is the direct involvement of workers operating in the property through the introduction of simple and streamlined internal procedures supported by easy to use ICT tools.

To start Planergy ™ it is prior necessary to insert the building configuration data into the database: this activity involves a technician for a typical work commitment of 1-2 days, depending on the size and on the complexity of the property. Thus, in a few weeks and with internal resources, a medium-sized local authority can start monitoring the usage and the energy behavior of its properties without having to acquire expensive equipment but only through its employees.

Young technicians, possibly within a specific training course on real estate management and on energy saving in buildings, can be employed for the initial tasks of collecting the configuration data of the buildings.

Once the property comes under Planergy control, a stable worker is in charge of the periodical data collection on energy consumption and on space utilization. through simple and quick operations. This task typically requires 5-10 minutes of the worker time each week. This person can operate either through a simple smartphone Application, or in the more traditional way, by inserting in Planergy™ the collected data through a client unit.

On a monthly basis, the technical body responsible for Energy Management examines the correctness of collected data and the overall system behavior. A workload of about 15 minutes for each monitored property is typically required to do this task. Through analysis and processing of the collected data it is therefore possible to define and take corrective actions involving both technicians and users.

The energy model supporting the Planergy™ analysis algorithms follows the so called[2] "Operational Rating" approach.

Through Planergy a public Administration can:

- build a data base of the buildings qualitative and quantitative characteristics which are related to their energy behavior;
- gradually put under control the use and energy performance of monitored buildings, thus obtaining an overall framework which allows to identify possible sources of inefficiency and to compare similar properties of different owners;
- issue of technical information necessary to set up one or more improvement Programs in a standardized, consistent and open form;
- publish data on buildings usage and consumption to involve professionals, firms and users and to educate the community on energy saving and environmental protection, thus spreading concrete and effective practices.

[2] Italian Technical Standard UNI/TS 11300 and UNI EN ISO 15603.

In presence of a regular monitoring activity and through a verification of contracts administration, a rationalization of the use of the facilities, a more careful behavior of the users it can be reasonably expected a reduction of up to 10% -15% of the current energy expenditure [2], [3].
The information provided by the service can also effectively support institutional communication and sustainability reporting [9] with special emphasis on environmental and social aspects.

4 EARLY FIELD EXPERIENCES

During the first half of 2014 and as part of the EU project "Alterenergy" (*Energy for Sustainability Adriatic Small Communities*), Planergy™ has been tested to monitor some properties of Agnone municipality (Molise Region, population: 5,028 inhabitants, altitude: 830 m. a.s.l).

In particular, the carried out activities were related to

- The selection of eight municipal buildings and of a reference meteorological station;
- A site survey for each selected building;
- The collection of buildings data and characteristics (drawings, dimensions, equipment data, space utilization etc.);
- Planergy Information System installation and roll out;
- Periodic energy data collection (one person employed to weekly register measurements from energy meters and the local meteorological station);
- Recorded data analysis and processing.

Table 2 outlines some preliminary usage and energy consumption results.

Table 2: Sample municipal buildings: observed data on Usage and energy consumption.

			USE				ENERGY CONSUMPTION		
Code	Property	Main Use	Total available area (in & out) (m^2)	Available Int. Area (m^2)	Used int. area (m^2)	Usage rate (%) (3)	Primary Energy (kWhp) (mean 2011-13)	Energy Perf. Index kWhp/m^2 (mean 2011-14)	CO_2 emission (kg CO_2) (mean 2011-2014)
1	Town Hall	Office	1.818	1.490	1.490	**81,5%**	**166.258**	**112**	**70.707**
2	Historic Public Library	Culture	2.940	1.823	1.570	**81,5%**	**95.297**	**61**	**37.605**
3	Historic Buiding		643	459	0	**0,0%**	**3.845**	**0**	**2.097**
4	Building	Office	1.738	1.532	485	**72,2%**	**50.294**	**104**	**22.950**
5	Building	Office	1.350	1.350	1.350	**46,3%**	**84.289**	**62**	**30.776**
6	Elementary School	Education	2.020	1.500	1.500	**96,3%**	**245.876**	**164**	**85.911**
7	Pre-school	Education	908	608	608	**83,3%**	**85.238**	**140**	**33.498**
8	Kindergarten	Education	470	220	220	**83,3%**	**10.818**	**49**	**3.323**

In the table, the *usage rate indicator* is conventionally referred to a weekly opening time of 54 hours. The full utilization of a building is usually the result of multiple property management measurements and interventions. The situation of each building of the sample is shown in *Figure 1*. The arrows denote the

impacts expected from some possible projects of intervention aiming at the full utilization and at the energy efficiency improvement of each building.

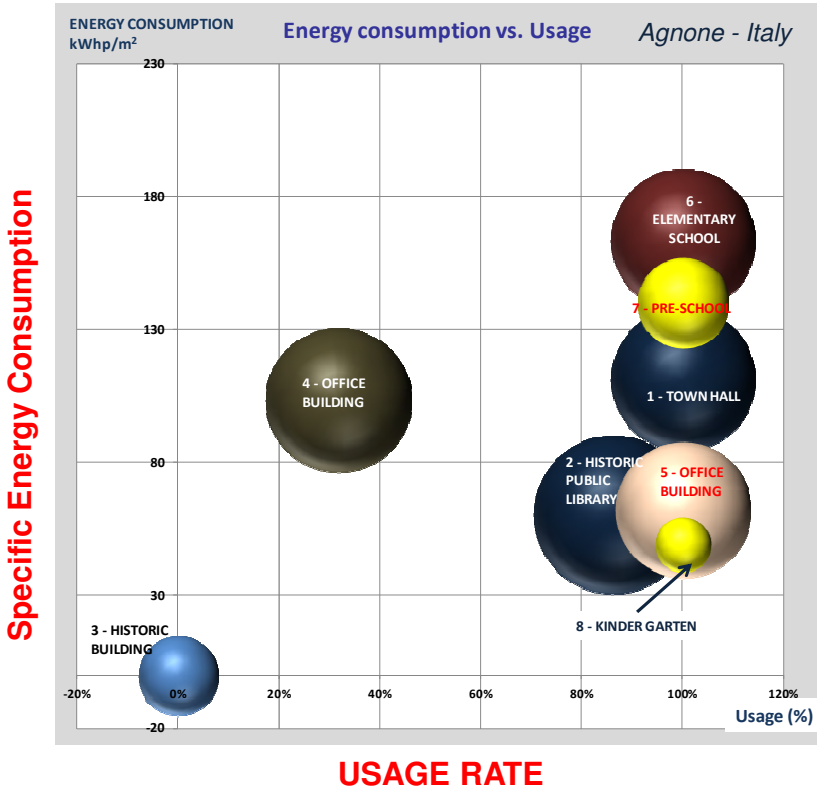

Figure 1: Sample municipal buildings: Percentage of Utilization versus Specific Energy Consumption. The radii of the bubbles are proportional to the surface area of the buildings.

5 OPEN DATA IN PLANERGY™

"Democracy" is an organizational system in which all stakeholders have the same rights and duties, but alone is not able to guarantee the effective participation of all stakeholders in decision-making. To enable real participation of all, suitable measures should be enabled to discourage the concentration of power in a few hands. Transparency and accessibility [5] [6] characterize the Open Data approach which is an effective instrument to fully excercise accountability.

The publication of the usage rate and the energy efficiency of each public building represents a democratic instrument for a confrontation between different interests and professionalisms.

Table 1 summarizes the information content [4] of the Open Dataset provided by Planergy ™. They originate from a specifically designed ontology named EiBO (*Energy in Buildings Ontology)* expressed in OWL2.

In practice, the information listed below are usually traceable in the context of different procedures performed by various organizational units of the Agency, each with a different task (e.g. Bookkeeping and maintenance). The adoption of the service allows to sort and process data in an organic manner ensuring their quality and regularity of publication.

Item	*Information*
Building stock	How many buildings and where? Why and how they are used?
Building characteristics	Configuration, main parameters and constructional features; main ordinary usage.
Building installations	How many installations? which building areas are served by each plant? Features of each main system.
Maintenence activities	New installations; technological measures adopted for energy efficiency. Changes in space utilization.
Property usage & social balance	To what extent were employed the available spaces for a given period? Unexpected events. Unavailability due to faults or structure degradation.
Climate	Climatic conditions in a given period
Energy flows	Energy consumed / produced by building equipment in a given period?
Energy & environmental balance	Primary energy consumptions (kWh). CO_2 avoided emissions. Improvements and trends.

Table 1: Main information items available in Planergy as Open Data Sets

The dissemination of recorded data as Open Dataset induces many potential benefits for the social communities.

- The approach is characterized by a broad vision able to include properties of all public bodies acting in the area.
- Through the monitoring action, solutions and initiatives aimed at the full use of the real estate properties can be easily identified.
- Firms and other socially active subjects in the area have the opportunity to propose documented and detailed projects of intervention to improve facilities and to increase the value of the public real estate portfolio.
- Projects should not be limited to an individual building but they can embrace a compendium of homogeneous interventions on several properties, thus leveraging economies of scale.
- The outcomes from the interventions implemented by each public administration can be publicly verified by comparing over time the achieved technical results with the initially stated objectives.
- The systematic publication of data and the constant vigilance exercised by the municipality and its citizens create the conditions to obtain and verify a gradual savings in municipal energy expenditures obtainable through greater care and attention from the public and from all other involved subjects.
- Specialized companies and qualified technicians will be able to analyze data and assess performance and costs of different buildings which are comparable in terms of location and of volume and quality of rendered services.

The results provided by Planergy™ can be used to periodically draft the Sustainability Report since they have a direct impact on environmental and on social issues. They also provide a periodic assessment of primary energy consumption and of the usage degree of each public building [8]. In the SEAP context [10], this information can be used to periodically update the section of the *Baseline Emission Inventory* (BEI) dedicated at monitoring the total energy consumption of public buildings.

6 CONCLUSIONS

Energy saving is not just the outcome of a good technical design but it is mostly the result achieved through a day-to-day rational and ordered behavior of all involved subjects.
Adopting Planergy ™, the public body implements those preliminary cognitive and monitoring activities which, in any case, will be usually required by professionals and specialized firms to design any improvements for public buildings.
Through the use of Open Dataset, it is possible to meet both the need of technical and scientific rigor as the need for a compliance with the standards of transparency [6], thus ensuring the involvement of large-scale business operators and of the citizens. The model presented also contributes to trigger the virtuous cycle[7] that links impartiality, transparency, publicity and participation which should inspire the action of any public body.

BIBLIOGRAPHY

[1] *Cresme Consulting: "Analisi procedure di affidamento di servizi finalizzati al miglioramento dell'efficienza energetica per alcune tipologie di edifici- Programma Operativo interregionale Energie rinnovabili e risparmio energetico 2007-2013"* POIN Energia Rep. March 2011

[2] J.S. Broc, P. Nogues, B. Bourges, J. Adnot, P. Baudry: *Can energy savings from operations promoting energy efficient behaviours in office buildings be accounted for?* Proc. IEECB April 2008.

[3] European Environment Agency (2013), *Achieving Energy efficiency through behaviour change: what does it take?*, Tech. Rep. ISSN 1725-2237 (No5/2013).

[4] Cresme Consulting Int. Rep. "*EiBO Energy Efficiency in Building – Ontologia di dominio*" April 2014 http://www.planergy.it/opendata/

[5] Agenzia per l'Italia Digitale- Presidenza del Consiglio dei Ministri (2013) *Linee guida nazionali per la valorizzazione del patrimonio informativo pubblico (secondo semestre 2013)*, (LG_Val_PSI_v1.0.doc 31 july 2013)

[6] Legislative Decree n. 33/2013 *Riordino della disciplina riguardante gli obblighi di pubblicità, trasparenza e diffusione di informazioni da parte delle pubbliche amministrazioni*. (13G00076) (GU n. 80 del 5-4-2013)

[7] De Fabritiis F. (2004) *Il bilancio sociale per il Comune e la Provincia- come svilupparlo*, Franco Angeli, Milano

[8] Mazzoleni M. *Il governo economico degli Enti Locali e la partecipazione dei cittadini. Il bilancio sociale come strumento di comunicazione e di controllo strategico*, Franco Angeli 2004 ISBN: 9788846459626.

[9] Tanese A. (edited by) (2004) *Rendere conto ai cittadini. Il bilancio sociale nelle amministrazioni pubbliche*, Edizioni Scientifiche Italiane

[10] JRC Scientific and Technical Reports, Bertoldi P., Cayuela D. B., Monni S., De Raveschoot R.P. (edited by) (2010) *Linee guida come sviluppare un piano d'azione per l'energia sostenibile- PAES*, (EUR 2436 IT- 2010), Luxembourg Publications Office of the European Union