Integrated Financial and Contracting Tools

Energy Performance Integrated Contract
D.T2.2.2

CE51 TOGETHER

INTERREG CENTRAL EUROPE 2014-2020

TOGETHER

TOwards a Goal of Efficiency THrough Energy Reduction

EPIC – Energy Performance Integrated Contract

D.T2.2.1

- PP1 – Province of Treviso
- PP3 – University of Maribor
- PP9 – Municipality of Paks

Executive summary

Energy Efficiency in buildings represents one of the pillars of EU policies and Public Administrations (PA) have an exemplary role in this issue.

Sometimes, though, PAs are not prepared to take up the challenge that energy efficiency presents, losing therefore the opportunity to achieve, from one side, economic savings that could benefit public finances, and from the other side the development of new skills that could stimulate new economic activities and job opportunities.

In this framework, Energy Performance Integrated Contract (EPIC) represents an innovative tool in the hands of PAs, as a new type of “integrated” Energy Performance Contract (EPC) through which technical and social aspects of energy consumption are considered together, and an improved energy performance of buildings is guaranteed not only by technological investments, but also by a better organization of the use of spaces and by the involvement of building users towards a more aware behaviour in the use of buildings.

The main difficulty in implementing an EPIC is the need of a widely prepared technical staff able to manage new and various topics: that means not only technical aspects, but also innovative types of contracts and, of course, the ability to manage the relations between different users and stakeholders. Next to the technical structure, a political support is required to allow the development of an EPIC, in order to strengthen the conviction, among all the stakeholders, that this experience, besides the difficulties, will reward all the efforts.

Once these aspects are accomplished, the EPIC guarantees more advantages than a classic model of EPC: besides the possibility to obtain higher savings through low or no cost interventions, as behavioural interventions are, there is a fundamental, even if not recordable, positive effect which is the educational aspect of behavioural investments. In this way, a Public Administration can contribute to build a more aware, proactive and responsible citizenship.

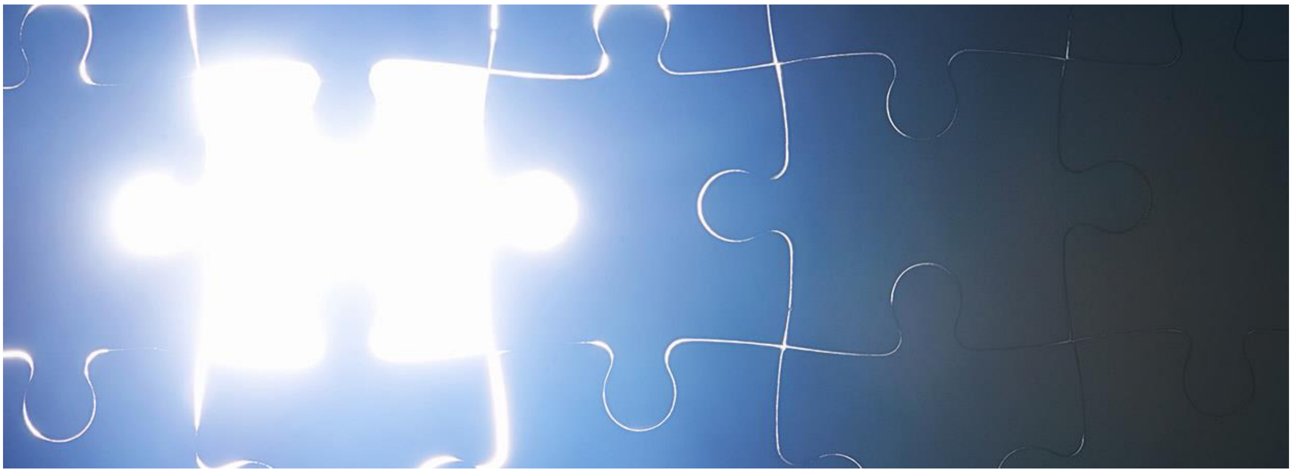
In this way, the experience of the Province of Treviso – acting as Lead Partner in TOGETHER project - represents a concrete example of how the involvement of building users for a better energy efficiency is an ongoing process, which develops and improves over time: the project TOGETHER, in fact, is the upgrade level of the previous project ‘Green Schools Competition’ for the Province, and the model of EPIC here presented is the result of three generations of Global Service contracts in which users are more and more the protagonists “Towards a Goal of Efficiency Through Energy Reduction”. Due to its remarkable experience the elaboration of the current tool was coordinated by the Province. Other project partners of TOGETHER - in which countries EPIC or even EPC is less well-known and often doesn’t compose a part of the everyday energy management of PAs – contributed by introducing their energy management methods at discussions and revising the document to be easily adoptable for any public authorities in the EU or even above.

Contents

1. Introduction

The Project TOGETHER offers a transnational capacity building platform, where partners with different levels of knowledge can strengthen their competences together, thus reducing their disparities and promoting actions on both the supply and demand side, in the context of planning EE in public buildings. The main goal of the project is improving energy efficiency and energy saving in public buildings by changing behaviour of building users and promoting energy efficiency measures.

This tool is contextualized within the framework of the second objective of the project TOGETHER: if the first project objective *"To increase energy efficiency and secure investments thanks to improved multidisciplinary in-house staff skills and thanks to an Alliance system with more engaged and motivated buildings users"* calls for the observation and learning of possible tools to be combined together for achieving energy efficiency in public buildings, the second one *"To produce and test the most appropriate combinations of technical, financial and Demand Side Management tools for the improvement of the energy performance of public infrastructures"* calls for the practical and concrete implementation of the possible identified measures.



1.1. Project TOGETHER

The three main objectives of the project TOGETHER consist in:

1) Increasing public buildings energy efficiency and securing investments, through the improved multidisciplinary in-house staff capacity building of Public Administrations and the establishment of a system of alliances with more engaged and motivated building users;
2) Producing and pilot testing the most appropriate combinations of technical, financial and Demand Side Management tools for the improvement of the energy performance of public infrastructures, currently in the 8 regional Pilot Actions involving a total of 85 buildings;
3) Codifying the project outcomes into a comprehensive policy package for a large-scale implementation, bringing local buildings governance practices to the centre of ambitious energy saving policies.

In its inception, TOGETHER plans the organisation of an interdisciplinary "Training of Trainers" course for building owners, managers and public decision makers that integrates the traditional technical inputs on energy management and buildings retrofitting with targeted contributions from behavioural science, economics and psychology, aiming to engage the end users in the building energy performance goals.

The "Training of Trainers" course is completed by the provision of an Integrated Smart Toolkit, including:

1) Guidelines for implementing the innovative EPIC (Energy Performance Integrated Contract) scheme, combining technological devices and behavioural-based components;
2) A set of exemplary models of Energy Management Systems in schools, institutional and other type of buildings;
3) An innovative Building Alliance concept among building owners/managers/users who cooperate within a Negotiating Panel to achieve energy savings to be reinvested through a Reinvestment Action Plan.

Additionally, and by the project's end, the Partners will jointly elaborate a Transnational Strategy and Mainstreaming Programme, including policy/strategic and operational recommendations for an appropriate follow-up and a sustainable take-up of the project outputs.

1.2. Purposes of the EPIC template

This deliverable provides a model of Energy Performance Integrated Contract (EPIC) for public infrastructures, through which a Public Administration can understand whether and how it is possible to implement this type of contract in its specific context.

1.3. Usage of the EPIC template

This deliverable aims at providing a model of Energy Performance Integrated Contract for public buildings. Through this tool, a Public Administration is guided in the implementation of an EPIC: next chapters describe why an "integrated" model of EPC is necessary towards Energy Efficiency (see chapter 2) and which are the common obstacles and challenges for a PAs in implementing it (see chapter 3). In chapters 4, 5 and 6 some organizational suggestions are provided, while chapter 7 is dedicated to the description of the experience of Treviso as a case study.

2. Model of Epic

2.1. Different EPC models

EPIC is the acronym of Energy Performance Integrated Contract. The term was first used to distinguish the Energy Performance Contract (EPC) operated by the Province of Treviso from other similar experiences.

More generally speaking, the term EPIC may be used to identify an evolution of a traditional EPC model, in which investing on technology is no longer the only way to achieve energy savings.

Therefore, the main feature of an EPIC model is the active involvement of the human components related to operation, maintenance and utilization of a public building, although in different ways, and at different stages of the process.

The EPIC model, in spite of having peculiar characters, is basically derived from traditional EPC models.

The EPC represents a very useful tool especially for Public Administrations, as the scarceness of financial resources makes it more difficult to invest towards an energy efficiency improvement of buildings. Moreover, a new model of energy contract is necessary to entrust EE interventions to the service provider (usually an Energy Service Company, ESCo), whose investments will be compensated in the following years through the savings in energy consumption, and the EPC has proved to be an excellent tool in this way.

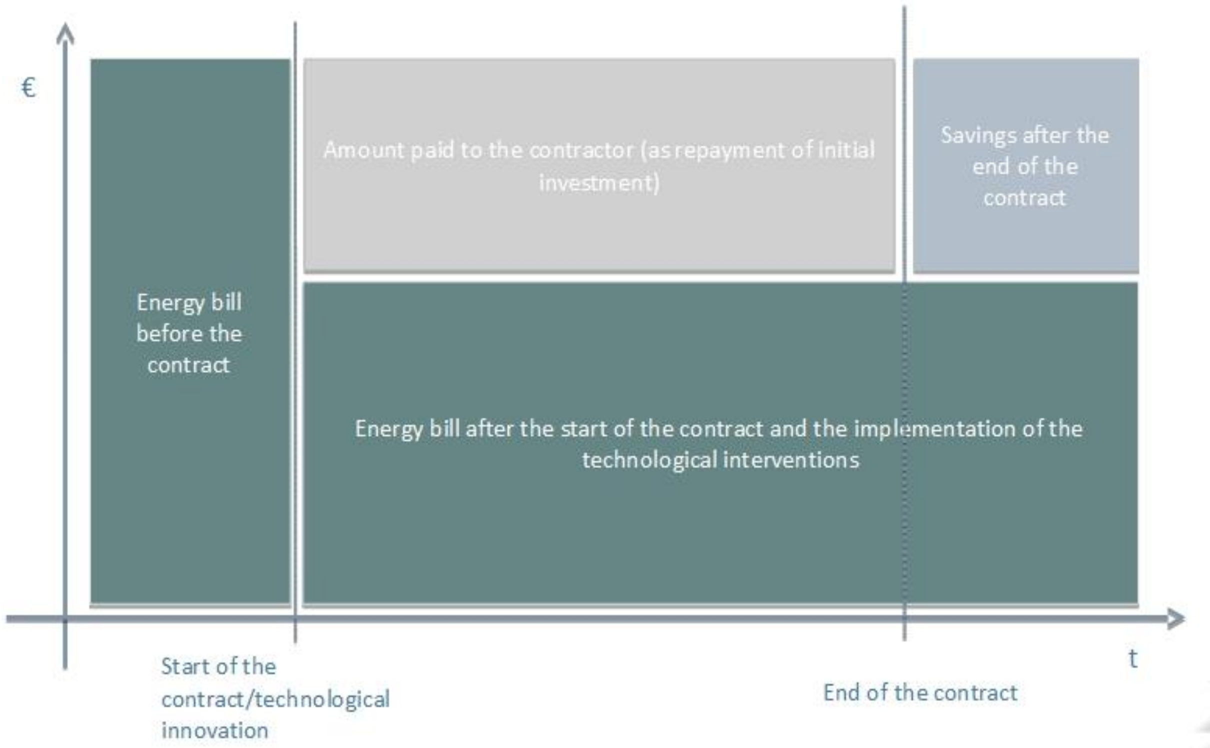


Figure 1: How a classic model of EPC works: advantages from the activation of an Energy Performance Contract for Public Administrations

Through an EPC, the risks of the investment are totally at the expense of the contractor, while PA in a first step only do the costs payment as same as was done before the contract. Moreover, in the process of

EPC implementation PA do not risk losing money, exactly the opposite, at the end of the contract PA can benefit by costs reduction for energy supply (due to less energy consumption after technological innovations implemented by the ESCo) and by a renovated building/plant system.

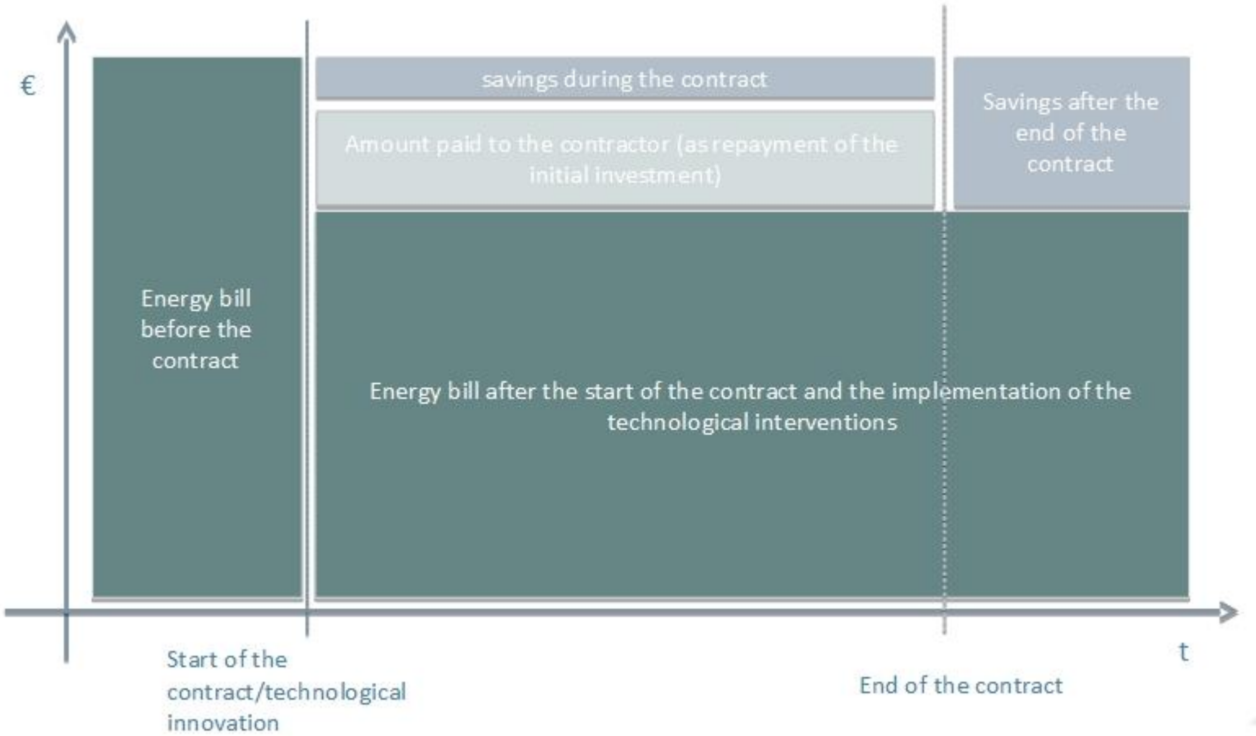


Figure 2: An example of upgraded EPC: Shared Savings EPC model

Even more convenient, is the "shared savings EPC" model, through which PA can get savings during the contract period itself, by sharing the economies achieved with the contractor.

On the other hand, in the case of "shared savings EPC", the final level of savings will be reasonably lower, due to the fact that the repayment amount provided to the contractor will be lower, as total savings will be shared with the owner.

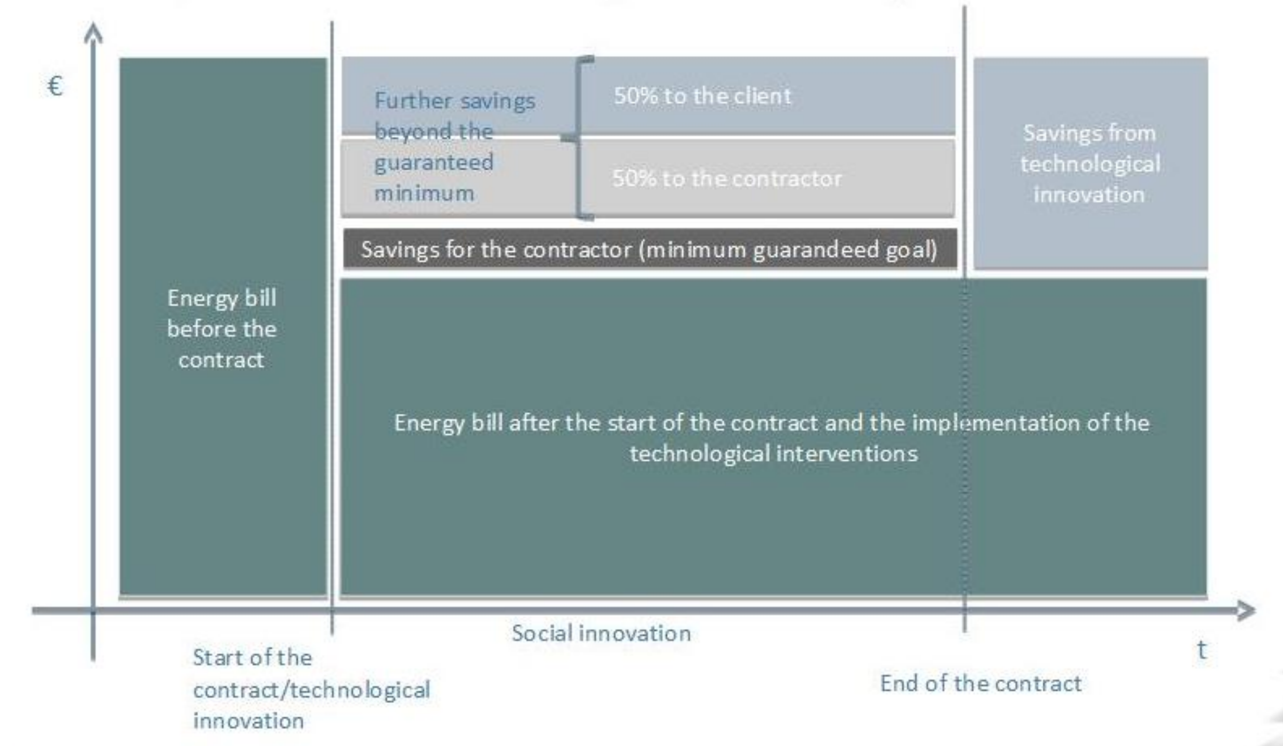


Figure 3: A further development EPC: Shared Savings EPC model with minimum guarantee

A further development is given by the “shared savings with minimum guarantee”, where the contracting parties establish a minimum goal of savings, in case the ESCo meets this minimum requirement, it is granted a pre-defined amount, normally corresponding to the economic value of the entire savings acquired. Further savings are equally shared (50-50) between PA and ESCo. This permits the ESCo to have a minimum profit guaranteed (assuming that the results are achieved) and incentivizes the company to raise their energy efficiency to increase its earnings. On the other side, the PA can benefit from a minimum guaranteed goal of efficiency, and from money savings.

2.2. Further evolutions of EPC

2.2.1. Integrated Energy Performance Contract (IEPC)

To address the facilities’ retrofits, an innovative model based on the holistic vision of the facility should be employed. The **Integrated EPC model** (IEPC) represents a contractual relation for full-service deep retrofits, based on the interests of all the involved stakeholders and their continuous collaboration, providing a performance guarantee that targets the highest energy savings and Greenhouse Gas (GHG) abatement, as well as improved comfort and functionality for the users[1].

[1] Integrated Energy Performance Contracting in Building Retrofit Projects. Ecosystem Energy Services Inc., 2014. New York, USA. Available: www.ecosystem-energy.com

As defined by Ecosystem[2], the IEPC consists of seven pillars, which are presented on Picture 4 and more-in-depth explained below.

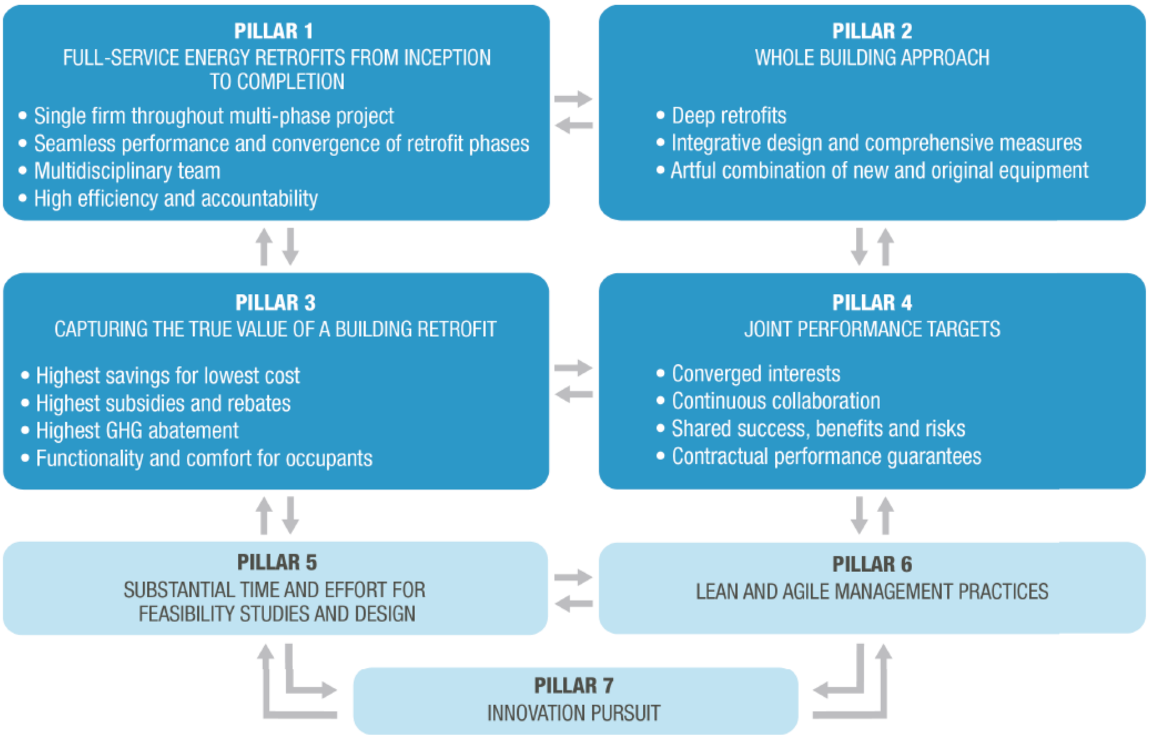


Figure 4: Integrated Energy Performance Contracting framework for facilities

Pillar 1: The highest value and accountability are generated when a single stakeholder (e.g. owner of the facility or a service company) directs and optimizes all phases of the IEPC project, including development and implementation with the expertise of a multidisciplinary team.

Pillar 2: The facility has to be seen as an interrelated system, and by carrying out the energy performance (design process, customized solutions, etc.) the whole building is taken into account to produce the highest long-term savings.

Pillar 3: The highest economic, environmental and social goals are targeted to maximize overall facility (project) value. The particularly effective economic method is the Net Present Value (NPV), while environmental are represented through GHG emissions, and social through increased comfort and functionality.

Pillar 4: The collaboration between the facility owners, professionals and service providers within one project team to reach the common objectives and performance targets. The current pay-for-work costs are reversed and excellence is rewarded when targets are surpassed.

Pillar 5: Comprehensive and well-planned designs are resulting in substantial energy and costs savings over the lifetime of the measures.

[2] Integrated Energy Performance Contracting in Building Retrofit Projects. Ecosystem Energy Services Inc., 2014. New York, USA. Available: www.ecosystem-energy.com

Pillar 6: Lean management targets and cost-optimized solutions with the highest savings capacity.

Pillar 7: Continuous innovation and outside-the-box thinking are essential for the development of optimal solutions.

2.2.2. Energy Performance Integrated Contract (EPIC)

The EPC is yet based only on technological investments, without considering social (organizational and behavioural) aspects that affect energy savings. This lack can have a double motivation:

- The awareness of the role of users in energy efficiency is a recent consideration; however, it is still difficult to define a model to record savings derived from social investments, which makes it difficult to define thresholds and percentage of profit ascribable to the obtained social results.
- The evolution towards a management of energy consumptions considering final user as an active and crucial stakeholder is a fundamental topic due to the increasing awareness that is catching on, starting from EU policies up to local level, about the role of users in the success of EE interventions.

Therefore, the aim of EPIC is the creation, by integrating organizational and behavioural aspects in the existing EPC model, of an investment plan including all the aspects of energy efficiency: technological, organizational and behavioural interventions.

Besides energy savings benefits with immediate effect, the involvement of users leads to the extra benefit of a raising awareness, of building users and of citizens in general, of the relevance of each ones' actions towards energy consumption, and of the complexity and costs of the building management.

These benefits cannot be taken into account in an ordinary financial analysis of the convenience of undertaking an EPIC. The educational added value of an EPIC should be considered as a key factor in a Cost-Benefit Analysis (CBA) approach, particularly for EPIC involving school buildings, in which case students, the most numerous category of users, may become an important factor of success, including energy saving issues in their curricula, by using serious games techniques to promote virtuous competitions.

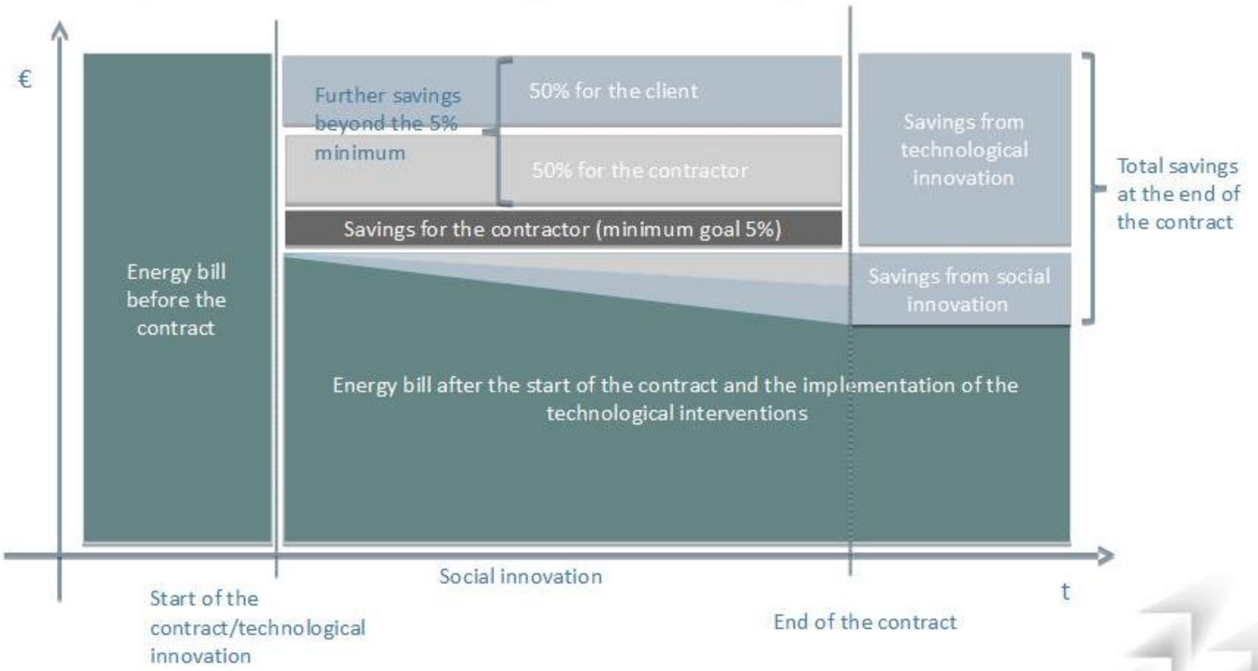


Figure 5: The model of EPIC

In EPIC, the reduction in energy consumption is based on two different types of investments, both operated by the contractor:

- Technological investments, usually adopted in traditional EPC models;
- Social investments, consisting in actions of various types, to promote, among the different categories of building users, responsible behaviours and rational managerial and operational procedures, favouring the achievement of an expected level of energy saving.

According to this distinction on investment types, another peculiar character of EPICs is the time in which the benefits of investments will be appreciated.

It is important to point out that the EPIC is more than just a financing mechanism. It represents a programme of practical engineered energy efficiency measures that are implemented in buildings to deliver real energy savings through heating, lighting, ventilation, air conditioning, peak load management, thermal insulation, controls and building improvements, and nevertheless improvements of behaviours and attitudes of building users. The intention is to keep the total energy consumption to a minimum – by way of demand side energy efficiency methods[3].

[3] Sustainable energy Authority of Ireland (SEAI). A guide to Energy Performance Contracts and Guarantees. Version: Draft for consultation. Available online: http://www.seai.ie/Your_Business/Public_Sector/Energy_Performance_Contacts_and_Guarantees.pdf (May, 2017).

2.3. Prerequisites for the successful implementation of an EPIC

"Building is a complex machine used by the human beings. The work of this machine depends on human activities and energy needs. Energy represents an increasing cost in terms of money and environmental resources".[4]

If we assume the building as a car, the goal of EPIC is to save energy through the improvement in both, the car's technological aspects (which may be related to EPC) and of the driver and his/her ability to drive (which goes beyond technological aspects, and is related to EPIC).

Energy consumption is influenced by the efficiency and suitability of the building/plants system, the appropriateness of use and operation procedures.

The knowledge of the "complex machine" (building) is of great importance to allow reasoned decisions on what to do. In addition to decide how to proceed, it is important to know the available resources: human, political, financial, professional, instrumental/technological. Finally, the external environmental factors must be taken into account. Like every machine, a building needs a driver, or better a professional driver, or a pilot when its technology is particularly complex, and a dashboard to provide all information needed for a safe and effective drive.

Before starting with the implementation of an experience such as the EPIC, it is necessary to verify the presence of some elements: for sure, the "material" context is necessary, and it is represented by the possible technological investments starting from energy audits, but, in order to integrate the social component, a relationship/interaction between owner, manager and final users of the building is indispensable.

[4] Adaptation from Le Corbusier - Vers une architecture - Le bâtiment est une machine a habitér

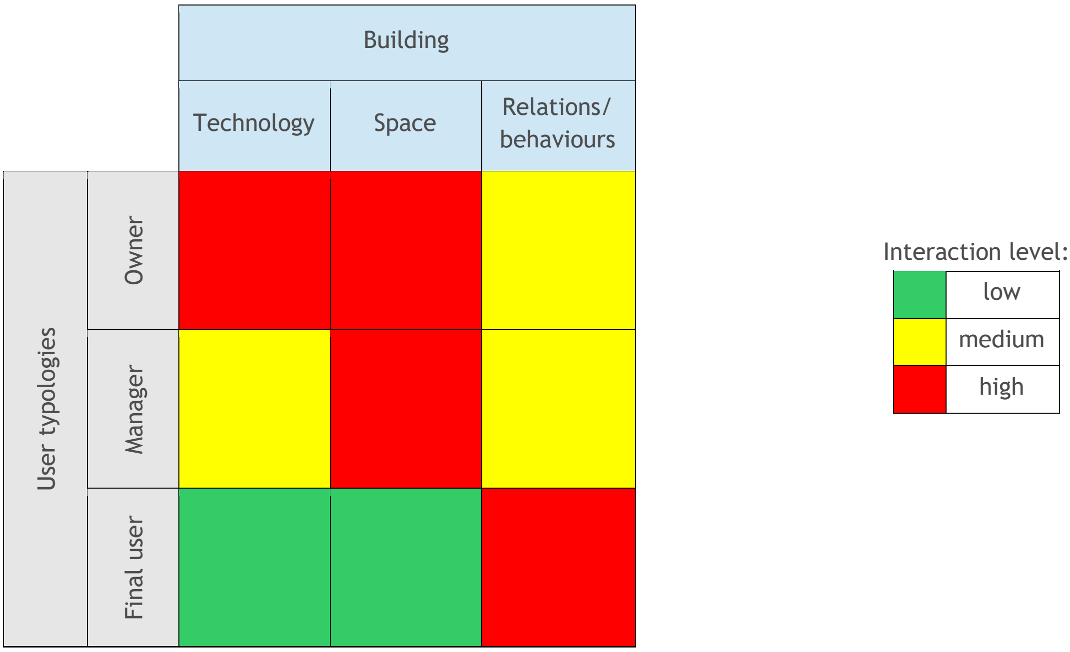


Figure 6: Matrix of building/users interactions

The matrix of interactions between building and users presented above represents a sketch of the elements that are part (and must be managed by users) of a building:

- “Technology” is the physical part of the building (heating/cooling system, building materials, etc.) and it is mainly under the control of the owner, which can invest economic resources in renovations or refurbishments;
- “Space” concerns the use of the building in terms of organization (time of occupation, etc.) and it is under the control of both the owner and the manager of the building, as they can decide who, when and how long the spaces of the building can be occupied;
- “Relations/Behaviours” represents what happens during the final use of the building, and it is mostly depending on final users.

If the owner is able to manage only the technological part of the matrix, then it is possible to implement an EPC and not an EPIC, as it requires <u>a good management of the whole complex of interactions</u>.

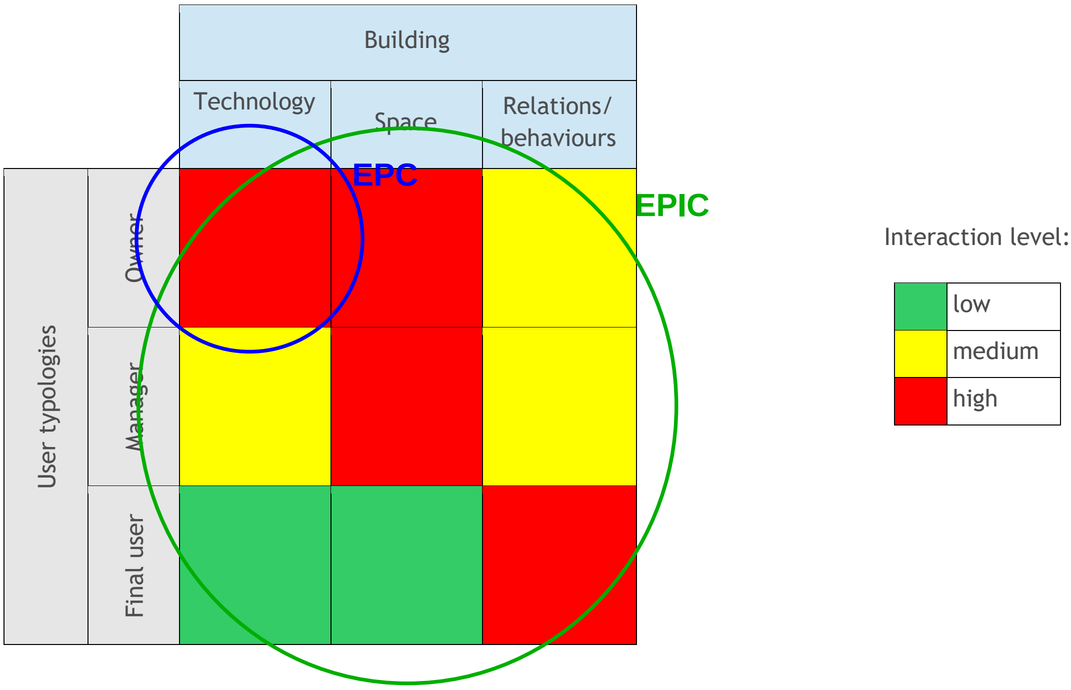


Figure 7: Matrix of interactions building/users: EPC vs EPIC

3. Organization for the execution of the EPIC

3.1. Challenges and barriers

Like all the innovations in managerial and contractual tools, setting up an EPIC is a challenging job. Since EPC itself requires an innovative attitude of PAs, which are usually reluctant towards the commitment of the whole management of energy services to an external party, the implementation of an EPIC represents a further evolution that needs even more innovative but essential elements to make it work.

The first and fundamental requisite is to have a **technical staff** that is adequately trained and **prepared to manage interactions with building users**, as well as to be **open to innovation** and experimentation. This can be obtained by:

1) supporting technical staff with non-technical human resources designated to manage the interactions between all the stakeholders involved in the future EPIC;
2) developing the awareness by technical staff that technology has not a value in itself, but it finds sense as it provides a service for people, so the machine must be considered in its relation with a human being.

Another important aspect is the **openness of politicians to innovation** and change, which is important to push, or at least not to stop, the process of implementation the EPIC.

Actually, the fact that the success of an EPIC depends on the quality of technical and political staff is of course a critical aspect for its implementation. From the other side, it must be considered that, once these prerequisites are guaranteed, through an EPIC it is possible to obtain relevant savings with reasonable investments, as non technological interventions usually are (communication, participation, gamification, etc.).

The aspects that a PA must consider in order to verify whether it is ready for launching an EPIC are detailed in this chapter.

3.2. Preliminary actions

When preparing a project on energy savings in public buildings, it is necessary to begin with the determination of the initial situation of the facility and of the human potential, with reference to all people who are involved, at different levels and with different roles and responsibilities, in the process of facility and energy management.

As with ordinary EPCs, the analysis phase starts with an energy audit of the facility. On this basis, energy saving measures (ESM) to improve the energy efficiency of the facility are then proposed. The final combination of ESM that will be implemented depends mainly on the economic analysis of the available options.

In ordinary EPCs, the preliminary information is usually provided by energy audits, integrated if necessary with further calculations or possibly inspection of buildings, and the initial draft solution is then prepared. The solution includes a list of the measures to be taken into account, together with the specification of the volume of necessary investments and the potential energy consumption cost reduction. This potential is sometimes referred to as the “crossbar height”, meaning the threshold in the metaphor of a high jump competition, to represent the minimum level of energy savings that the contractor is expected to achieve (calculated with reference to previous energy consumption scenario). On the basis of this information the customer makes a decision as to whether further procedures are acceptable for him/her.

Unlike in ordinary EPCs, in which the technological and financial analysis is usually sufficient to provide the facility owner with all necessary information to take the appropriate decisions in order to activate or not the EPC, the preliminary phase of EPICs requires further steps.

The EPIC, actually, differs from ordinary EPC mainly for the contribution of human attitudes and behaviours to the savings expected in the contract lifetime. Therefore it makes sense that in the preliminary phase of an EPIC the human background needs to be properly taken into account, in the same way as the technological features of the involved facilities.

Based on the above figures 6 and 7, an EPIC requires the following preliminary actions:

- Definition of the project group, composed also by external experts and external service providers, to set up a multidisciplinary team able to deal with both technical and social issues in the process of EPIC implementation;
- Clear definition of goals, including the highest possible savings and relative retrofit phases (e.g. feasibility study, design, financing, etc.). Getting into detail this shall include:
    - a feasibility study, including financing (co-financing options);
    - procurement documentation, e.g. request for proposal, terms of reference, evaluation procedures, duration and milestones of the contract, clear and transparent list of obligations for each contracting party, reference dates to achieve the savings, etc.;
    - a sound development of the financial documentation of the project where proper baselining, savings calculations, cash flows and financial indicators enable both parties to check the project realisation (savings achieved) and carry out a clear and transparent distribution of the financial benefits according to the contract.
- Initial or state-of-the-art assessment, studies and analyses of data, including historical data (selecting and defining a measurement boundary and baseline energy use study, and energy consumption behavioural studies by users).

3.2.1. Investigation of the human background

In order to verify the suitability of the human background, the following two different aspects must be assessed, namely the suitability of the internal organization of the PA’s structure in charge of the implementation, and the suitability of the building users’ characteristics and organization.

I. **Suitability of the internal organization**
    1) Political background
        a) is the political management of the public body that promotes EPIC available and prepared to support innovation?
    2) Professional (technical and administrative) background
        a) How is the public body promoting EPIC organized? Is there a technical structure/office managing the building stock?
        b) Is the **technical** staff adequately motivated and experienced to take into consideration and adequately manage the relation between machine and human being?
        c) Is the **administrative** staff open and experienced to manage non-conventional contracts?

3) Relationships between different subjects/roles
    a) Is there, in the public body promoting EPIC, a structure in charge of the management of relations with buildings users?
    b) If the above mentioned structure exists, is it available to interact with the office that manages public buildings and vice versa?
    c) Is there, in the Company in charge of the energy service management project staff, a person who is potentially able to trigger a process for a better management in terms of the organization of the use of spaces? Is there a person who is able to be the "eco-motivator" for buildings users?

II. Suitability of the building users' characteristics and organization

1) Types of users
    a) Which types of users will be involved in social investments? Three categories of users must be considered:
        - users that occupy regularly the buildings for education (from kids at the Kindergarten to students at University);
        - users that occupy regularly other buildings (e.g. employees in public offices, medical staff in hospitals, etc.);
        - temporary users (e.g. students in a library, patients in a hospital, visitors of a museums, etc.).
    b) Which is the prevalent type of users in buildings involved in the EPIC?
2) Is there an organization in charge of the building's utilization (e.g. time of operation, use of space, cleaning, etc.)?
3) Is it possible to identify an "eco-motivator" in the building's staff?

It must be clear that a positive answer to all the questions listed above is not the essential pre-requisite for the implementation of an EPIC. The questions shall rather be seen as a preliminary check for the suitability of both the owner's and the user's organizations, before undertaking such an ambitious endeavour.

Weaknesses in one or more of the analysed aspects may be present, without necessarily jeopardizing the final result, provided suitable reinforcement actions are foreseen during the preliminary and the implementation phases of the process.

3.2.2. Designing a project team

Once the preliminary investigation of the human background is completed, a project team needs to be set-up.

In an EPIC project team, unlike in EPC where technological skills will prevail, technologists and engineers, as well as administrative and financial experts will be supported by other professionals, not necessarily strictly defined, with the main function of identifying the potential savings achievable through behavioural changes (behavioural DSM).

Additionally, engineers should change the ordinary perspective of an EPC, considering that further potential savings might be achieved thanks to analytical DSM.

It is important that the "EPIC project group" takes or supervises the project from inception to completion. The project group should consists of all the facility's stakeholders (owners, in-house professionals, external experts, service companies, users, engineers, financial manager, incentive/subsidy specialists, communication personnel, technical instructors and supporters to the users and owners, etc.), who need to be in a frequent communication e.g. evolutionary conversation, proposing solutions, receiving feedbacks, necessary to set the goals and further implement the measures. Such multidisciplinary team is brought together in the initial phase and collaborates to enhance solutions throughout all the project phases. In the EPIC, the expertise is not fragmented as in traditional engineering projects, but it is transferred from one phase of the project to another. As suggested by Ecosystem (2014) any subcontracted expertise is specific, and does not represent an outsourcing of the whole phase.

This project team will be composed differently based on the phase of the implementation of the EPIC: in the first phase of planning, users and building stakeholders will be not involved in the process, while in the second phase of real implementation of the EPIC all the stakeholders, users first, will be included.

3.3. Implementation

On completion of the EPIC with a guaranteed result, steps leading to the installation of the agreed measures are commenced. Based on the prepared project background documents, the comprehensive project documentation is prepared and all contractually agreed measures are installed and implemented shortly afterwards. Duration of implementation of the measures depends on size and complexity of the project[5].

3.3.1. Integrating the project team

As mentioned in chapter 3.2.2., the project team of an EPIC is somehow “variable” according to the multidisciplinary characteristic of the tool, and needs to be adjusted, depending on the different stages and on the different features of the building’s users.

At the beginning of the process the team, as mentioned above, will not substantially differ from that devoted to an ordinary EPC, with the exception represented by the need of a specific skill, in order to detect the potential in terms of users’ participation, and to identify a realistic set of tools and incentives (not necessarily economic) aiming at enhancing participation of the highest possible number of people (users), to change their habits and behaviours. The general aim is to favour, in this way, the process towards Energy Efficiency that has been (or is being) undertaken thanks to technological investments on the buildings.

3.3.2. Installation and implementation of energy efficiency measures, including behavioural issues

After the development of the tailored energy efficiency solutions, owners’ needs as well as users’ needs must be considered, and measures needs to address their preferences and behavioural issues. The proposed measures need to maximize the interconnections between building systems. Re-engineering of the building system includes evaluating the existing infrastructure and existing habits of the users, proposing measures that will meet the specific needs of the building and its occupants. It is suggested to re-use certain parts of the existing system in order to reduce the initial investments costs and to select such new installations that are right-sized to meet the specific needs and to ensure there are no

[5] Sustainable energy Authority of Ireland (SEAI). A guide to Energy Performance Contracts and Guarantees. Version: Draft for consultation. Available online: http://www.seai.ie/Your_Business/Public_Sector/Energy_Performance_Contacts_and_Guarantees.pdf (May, 2017).

unnecessary energy losses[6]. Ecosystem[7] further suggests to consider building retrofit from a holistic perspective:

- Building technology, overhaul of energy systems: high performance equipment, regulation, building management and control system, HVAC (heating, ventilation, air conditioning and cooling), lighting;
- Measures on the building envelope (e.g. insulation, replacing windows, green roof, etc.);
- Integration of renewable energies and distributed generation (biomass, solar panels, geothermal energy, cogeneration);
- Awareness raising campaigns to foster energy efficiency culture among all buildings occupants.

3.3.3. Trial and guaranteed operations

Proper operation, maintenance practices, and monitoring are tasks critical to the ongoing energy-efficient performance of the building's systems. Measurement and Verification involve reliably **quantifying the savings** from energy conservation projects (or individual ECMs) by comparing the established baseline with the post-installation energy performance and use, normalised to reflect the same set of conditions.

The checking process is often delegated to a specialised consulting firm, usually the EPC process facilitator who originally assisted with organisation of the procurement.

In some cases, the evaluation of actual achieved savings may also be carried out only at the end of the contract.

3.3.4. Innovations

Continuous innovations are essential for the development of optimal solutions. Applied solutions coupled with the academic research will shape the measures that bring the most value. The ability to identify new opportunities and solutions, and to apply them to a particular project, represents a key. Innovation should not be vertical, but included in all the project phases[8]. J.P. Morgan[9] also suggest the following best practices:

Compare efforts required for handling energy efficiency initiatives internally vs. the holistic approach.

- Clearly define the scope of work, identify EPIC-related responsibilities;
- Make the EPIC decision process inclusive across all stakeholders;
- Conduct a thorough energy audit of facility systems – lighting, heating, ventilation, air conditioning and water;
- Align goals with recognized energy conservation protocols;

[6] Integrated Energy Performance Contracting in Building Retrofit Projects. Ecosystem Energy Services Inc., 2014. New York, USA. Available: www.ecosystem-energy.com

[7] Integrated Energy Performance Contracting in Building Retrofit Projects. Ecosystem Energy Services Inc., 2014. New York, USA. Available: www.ecosystem-energy.com

[8] Integrated Energy Performance Contracting in Building Retrofit Projects. Ecosystem Energy Services Inc., 2014. New York, USA. Available: www.ecosystem-energy.com

[9] Integrated Energy Performance Contracting in Building Retrofit Projects. Ecosystem Energy Services Inc., 2014. New York, USA. Available: www.ecosystem-energy.com

- Engage unbiased third party to review/confirm results of measurement and verification reports/savings;
- Increase the chances of securing financing with the best terms possible. A realistic plan can boost investor confidence in your energy efficiency initiatives.

4. Measurement and verification

The transparency of the savings achieved depends on the quality of measurement & verification (M&V) provided. In general, the more independent M&V is from the ESCo, the more transparent are the energy savings. To establish the impact of energy efficiency in a facility, a set of rules must be agreed to measure and verify the savings. This is called Measurement and Verification Plan, including all the records of the baseline energy studies/analyses, measurement boundaries, methods of measurement, the adjustments (e.g. changes in the weather conditions), and calculation methods of savings.

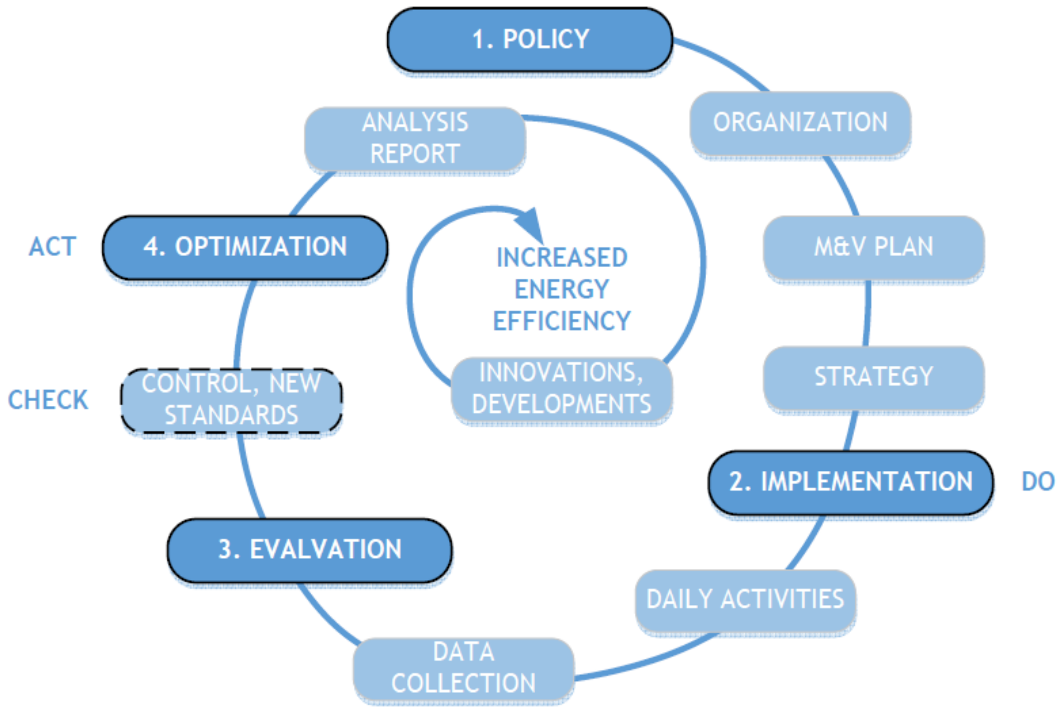


Figure 8: The Measurement and verification plan in the framework of a Common protocol for Energy Efficiency

The process is in detailed explained within the TOGETHER deliverable D.T2.1.2 Common Protocol which contains technical guidelines for savings measurement and verification, here below summarised.

The Energy & Measurement plan must contain:

- Description of the outcomes/intended savings – a realistic prediction of potential savings linked to the technological/social interventions;
- Identification of facility and “measurement boundary”, that should be selected so that the savings will be high enough to be confidently discriminated from the Baseline Energy data;
- Determination of the facility baseline year, documentation of the conditions and energy data (such as documented audits, surveys, inspections, metering activities). This info should include:
    - energy consumption and demand profiles of the facility;
    - occupancy type, periods, time;
    - space conditions for each period, season, equipment inventory (data, location, condition), equipment operating practices (schedules, actual temperatures/pressures, setpoints, etc,), any significant equipment problems or outages, existing patterns (linked to the users' profiles and management of the facility), etc.;

- Identification of planned changes (if any) – technological and behavioural/social;
- Identification of post-retrofit period e.g. ensuring regular switching off of lighting, appliances and equipment, when not in use; introduction of ISO 50001; smart control system, etc.;
- Set of conditions to which energy measurements will be adjusted (if needed), referring to the conditions from the pre-retrofit period;
- Specification of measurement and verification will be based on the following options:
    - the whole facility/building – energy use is measured by utility meters for at least 12 months (billing data, regression analysis, using historical data to develop a model of the energy performance of the building;
    - specification of data analysis;
    - procedures, methods, assumption details, including details of metering, missing data, uncertainties, etc.;
    - documentation and data sources, including their availability;
    - financial and other requirements.

It is important to point out that this model is a good tool for an EPC, but in the case of an EPIC consumption reduction comes from different interventions (technological and behavioural), therefore it is necessary to establish a method to distribute savings, with the additional problem that results of behavioural interventions are difficult to be recorded. A possible solution could be elaborating a predictive model of consumption variation measurement related to technological interventions, attributing the remainder to behavioural interventions.

5. Public procurement

The procurement or invitation to tender can be prepared once a project has been identified and the goals have been set, the first feasibility study has been performed, and the organization of the project has been established (see chapter).

The applicable rules governing tenders, e.g. issuing the invitation and the typology of the procedure, should be determined. Further details concern the contract specifications, the requirements asked to participate to the competition, and the awarding elements and criteria to be used for the assessment of the tenders.

Also, the dates and terms must be determined[10], including the milestones of the contract and a period of notice. It is suggested that the invitation also includes detailed specification on the following issues:

- clear and transparent list of obligations of the contracting party;
- reference date(s) for the saving;
- clear and transparent lists of steps to be performed to implement the measures, associated with costs;
- regulations specifying the inclusion of any subcontracting with third parties;
- clear and transparent display of financial implications of the project and of the distribution method to be used between both parties of the monetary savings achieved;
- provisions on measurement and verification of the guaranteed savings;
- quality checks;
- contract changes/annexes (e.g. changing energy prices, use intensity of an installation);
- detailed information on the obligations of each of the contracting party and of the penalties for their breach[4].

The Guidelines for energy performance contracts[11] tenders is suggesting the following 10 tips (see Table 1).

[10] Boot Advocaten, 2015. Guideline for tenders for energy performance contracts. Publication prepared by RVO NL as a part of the Energy Conservation in the Built Environment programme of Ministry of the Interior and Kingdom Relations, the Netherlands.

[11] Seven – the energy efficiency centre. Energy Performance Contracting Manual: Project Transparense – Increasing transparency of energy service markets, Prague, 2013.

Table 1: 10 tips for contracting authorities in a case of performance energy related contracts

1	CLEAR INSTRUCTIONS	Devote time to the specification of requirements to be submitted to the fulfilling party. Consider which performance indicators are important. Be clear and act as an intelligent client. Accept that you cannot do this 100% comprehensively and perfectly.
2	CONFIDENCE	Develop a relationship based on trust and strive for a win-win situation. Agree on what to do if trust is lost. Talk to each other about expertise.
3	CONTRACT MANAGER	Appoint a contract manager who is knowledgeable about buildings, energy, and procurement and who can deliver results.
4	AVAILABLE DATA	Make a baseline measurement. Set out what will be measured and how. Make as much data available as possible about the building and its energy consumption history.
5	OPEN QUESTIONS	Ask open questions. Ask the fulfilling party to propose performance indicators and innovations.
6	FLEXIBLE	Ensure a flexible contract that can accommodate changing circumstances, such as changing hours of use and occupancy rate.
7	COMMUNICATION	Create a clear and open communication structure and include it in the contract: who communicates with whom, in what manner, and about which subjects.
8	EMPLOYEES	Take account of employees' experiences in the specification. Listen to the employees who will have to deal with the consequences of environmental changes.
9	EXPECTATIONS	Manage end users' expectations of the environment and services to be provided under the contract.
10	MANUAL	Ask the fulfilling party to prepare a building use manual for end users and building managers.

In this case, the ESCo is requested to obtain a certain level of savings by realizing a series of technological investments, which are proposed in response to a public tendering procedure and assessed by the public administration.

5.1. EPC and EPIC awarding evaluation elements

Besides the legal and administrative procedures that must be taken into account to draw up a public procurement, which are not the aim of this work, it is worth considering which evaluation elements the PA could adopt to choose the best offer received.

In the case of an EPC, three main elements must be taken into account for the evaluation of tenders:

- **The overall economic savings guaranteed**: this is probably the main goal of a PA implementing an EPC and it depends also – but not only – on the 2nd and 3rd criteria. Indeed, the cost paid by the

PA is also related to energy selling price applied by the Company, which can choose to guarantee a minor cost of its service due to a lower energy cost instead of an energy consumption reduction.

- **The investments proposed**: the evaluation of this criteria requires a careful and expert analysis, by the PA, to verify the coherence between the cost of the investments declared and the real activities that will be carried out by the Company, which means that the tenderer must declare, in addition to the amount of investments, also a description of them. From the other side, the company should be able to find the right balance between an advantageous economic offer and a satisfactory set of investments.
- **The foreseen reduction in energy consumption**: regardless the economic savings, a PA can insert in its evaluation environmental criteria, with the aim of contributing to the EE improving in its territory.

The result of the evaluation, and the consequent successful tenderer, depends on the weights given to each evaluation element, based on the objectives and outcomes that the Public Administration wants to achieve.

In the case of EPIC, the PA will require that a part of the investments proposed by the ESCo is addressed to social improvement, which can be both organizational and behavioural.

Many different sets of criteria have been developed and proposed for evaluating bids in the awarding process of an EPC, and the search and selection of successful examples may lead to identify a convenient starting point, although not specifically tailored to an EPIC, for the identification of a suitable set of bid proposal contents and evaluation elements and criteria.

A well structured set of elements for the awarding of an EPC contract, for instance, was recently defined by the Metropolitan City of Turin, to award a public competition held in the framework of the project 2020TOGETHER[12].

The project 2020TOGETHER, activated by the Metropolitan City of Turin thanks to European funding, has as its purpose the implementation of measures to improve energy efficiency of buildings and public lighting. One of its main actions is the research and promotion of new forms of contract, in line with the guidelines of the Energy Performance Contracting. In the model of public procurement adopted by 2020TOGETHER, only technological investments are considered and assessed, since the project was related to the improvement of the traditional EPC model, rather than to the search for new contractual models including energy efficiency investments other than the technological ones. This form, on the other hand, appears clear, effective, and considering also the content of the tender documents, it reduces the margin of discretion in the evaluation. Such model can be adapted to the case of EPIC, taking into consideration also social investments, as described in the following schemes.

5.2. Example of EPC bid evaluation methodology

In the above-quoted example related to the 2020Together project, the bid proposal is based on the following contents:

[12] Acronym of 2020 TOrino is GEttingTHERe, no links with the Interreg Central Europe TOGETHER project, under whose framework the present work has been made possible. 2020TOGETHER is a CIP - IEE, Intelligent Energy for Europe / Mobilizing Local Energy Investments – MLEI project. Project partners are the Piemonte region (LP), the Metropolitan City of Turin, the City of Turin and Environment Park S.p.A. More details at: http://www.cittametropolitana.torino.it/cms/ambiente/risorse-energetiche/progetti-energia-sostenibile/2020together

- Technical bid:
    - Preliminary design of each of the proposed technological investments, including a specification of the following O&M process;
    - List of minimum guaranteed energy savings for each of the buildings included in the contract;
    - List of the single technological investments (more investments per building are possible, e.g. windows substitution, boiler replacement, etc.) specifying the expected life-time duration;
    - Share of the minimum guaranteed savings achieved with investments in RES.
- Financial bid
    - Total amount of the proposed investments, specified by building and by technological investments within the same building;
    - Yearly amount of fuel (related to the minimum guaranteed performance) and O&M fee.

To ensure uniformity in the evaluation, proposals are submitted only according to a pre-defined format.

Table 2: Elements of evaluation in the 2020Together model

Elements of evaluation		Pts.		
1	Minimum level of guaranteed Energy Savings	22	60	Technical evaluation parameters
2	Useful life time of the proposed investments after the end of the contractual period	20		
3	ESCO certification (UNI - CEI 11352)	2		
4	Quality of O&M plan	2		
5	Further CO2 emission reduction (thanks to increased investments in renewables)	8		
6	Clarity and completeness of the proposal	6		
7	Amount of the proposed investments	20	40	Economical evaluation parameters
8	Overall monetary savings amount	20		

In the proposed evaluation grid, the scores corresponding to the evaluation elements under the numbers 2 and 8 are assigned according to a pre-determined grid, in which different typologies of investment are linked to specific values of useful life-time or to specific values of CO_2 emission saving, with no margin of discretion in the assignment.

It is to be noted, in particular, that this evaluation grid is related to the awarding of a 13 years lasting contract, and the importance given to element n. 2 is probably related to the will of promoting investments in the building shell's insulation, definitely more long-lasting than investments on services replacements, although 13 years is probably still too short a period to allow a complete amortization.

Similarly, no margin of discretion is present under the element number 1, as it represents the competitor's commitment in the achievement of a minimum level of savings, a parameter that should be coherent with the number and the typology of the proposed investments. A higher value of this parameter in comparison to the level that is reasonably allowed by the investments made, will grant a higher score and a consequent higher chance of being awarded the contract but, at the same time, it will expose the bidder (once he becomes the contractor) to the risk of non-compliance and to the consequent economic and legal sanctions provided in the contract.

Since no margin of discretion is obviously present in the economic evaluation elements n. 7 and n. 8, and in the element n. 3 (a certification that can only be present or not) the residual overall margin of discretion is limited to the total of 8 points out of 100, as foreseen by elements n. 2 and n. 6.

5.3. Proposed evaluation grid for EPIC

The bid proposal contents and the evaluation grid can be adapted to the case of EPIC, introducing some typical elements of this innovative contractual formula, and adapting others to the modified general context.

The evaluation grid proposed for the EPC of the Metropolitan city of Turin, shown on, and consequently its adaptation to the case of EPIC is anyhow understandably influenced by the peculiar characteristics of the contractual model to which it was related. As mentioned above, this model is referred to a 13 years long contract, with the request (and the expectation) of bids proposing important technological renovations, or even improvements in the building shell, such as windows replacement and walls insulation, and with an explicit request for the implementation of new renewable power plants. In such a model, the operating life of equipments and the level of investments in renewables was considered a major issue, with a consequent highly rewarding score in the public competition.

On the contrary, the contractual duration of an EPIC will probably be shorter than 13 years, if only for the still experimental nature of this methodology. Another reason for an EPIC to be shorter than a traditional EPC can be found in the reasonably lower expected level of technological innovations, since a relevant, or at least not negligible part of the overall energy savings should be achieved through social or behavioural actions.

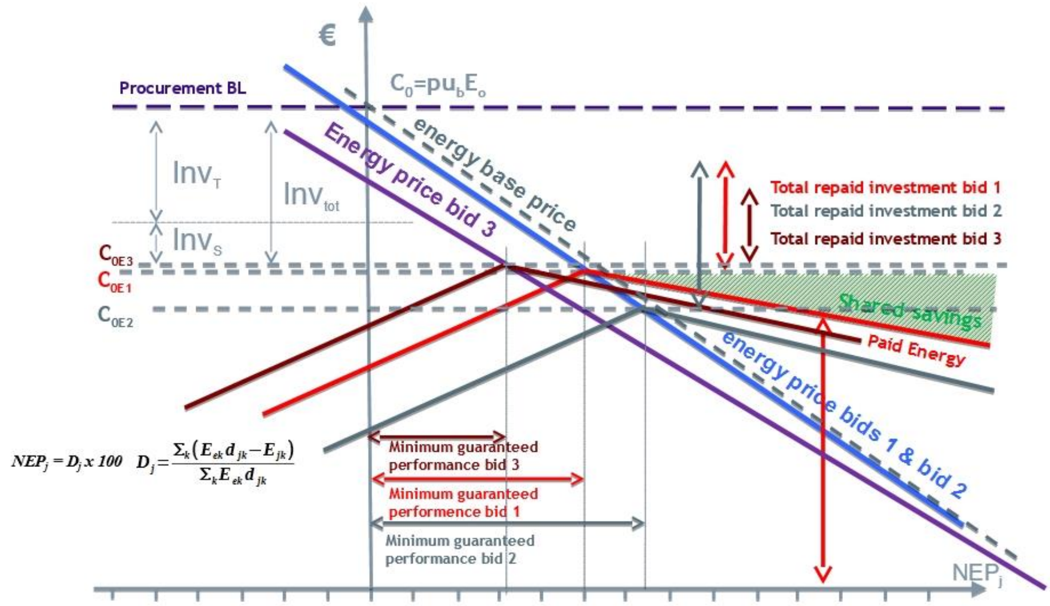
Another important issue related with EPIC is the higher power of agency that users have on electric energy rather than on thermal energy. In buildings like schools or offices, where users spend permanently their time, they can easily play an active role with simple behaviours like switching off the lights when they leave a room, with a consequent immediate and measurable reduction of energy consumption. This is not so easily done with thermal energy, if only for the thermal inertia of a building, that prevents the appreciation of the same real-time cause effect relation that exist with electricity between switching and lighting. This means that technological investments in electric plants renovation could be low, or in any case not necessarily long-lasting, or even none at all, since higher is the chance of reducing consumption through social and behavioural actions. Besides, technological investments allowing to save electric energy do not require important investments like walls insulation or frames substitution. Consequently the payback period will be shorter, and the same will be the contractual duration. The use of expected useful life of installed technologies as an evaluation element could therefore be inappropriate.

The upgrade from EPC to EPIC brings out a further complexity related not only to the duration, but also to the execution time of the investments: while for technological investments it is assumed that they will improve energy efficiency within a specific, and relatively short period, in the case of social investments, especially for behavioural changes, this is not predictable with reasonable certainty and, furthermore, it is still not clear whether behaviours need a constant motivation activity or they settle in at one stage.

On the basis of these considerations, it could rather be appropriate to identify two separate evaluation elements for the reduction of electric energy and of thermal energy consumption.

As a result of the above-quoted remarks, the evaluation grid for an EPIC needs to be adapted, and for some aspects even simplified, compared to that of an EPC, also considering the following diagram (Figure 9), in which the relation between amount paid (€) and results (expressed in terms of EP, or better NEP[13]) is shown. In particular, the correlation between the amount paid for energy and NEP is linear and thus represented by a straight line.

The “baseline” is represented by the total energy consumption price (price per unit of energy multiplied by the overall energy baseline) corresponding to NEP=0, and the bidders will be requested to propose a minimum guaranteed level of NEP, and a lower price for energy. Each bid will be represented by a specific straight line, which intersects the “NEP” horizontal axis in the point NEP=100, and the vertical axis in a point corresponding to the amount which should be theoretically paid as total energy consumption price for NEP=0, considering the specific energy price of the bid.



$$NEP_j = D_j \times 100 \quad D_j = \frac{\Sigma_k (E_{ek} d_{jk} - E_{jk})}{\Sigma_k E_{ek} d_{jk}}$$

$$C_{Ebid} = C_{0E}\left(1 - \frac{NEP_{bid}}{100}\right) \quad C_{0E} = pu_{bid} E_0$$

$$C_j = Inv_s + Inv_T + \tilde{pu} \cdot [Ej + 0{,}7(Eoj - Ej)] + \tilde{C}m_{epc}$$

Figure 9 - Examples of evaluation process

13 NEP – Normalized Energy Performance represents the level of Energy Performance corrected through normalizing factors, to consider differences in the dimension or utilization of the buildings that may occur during the contract, and the influence of climate, in the case of thermal energy.

In this context, the competition could be based on two main parameters:

- The minimum guaranteed performance
    - *Evaluation criterion: highest score to the highest performance*.
- The overall amount paid for energy (offered price per unit of energy carrier multiplied by the energy consumption corresponding to the achievement of the minimum guaranteed performance) and investments (including the support provided to social/behavioural actions)
    - *Evaluation criterion: highest score to the lowest overall amount*.

The price paid for energy, will be represented by the intersection of the straight line representing the offered price of energy and the vertical line representing the minimum guaranteed performance.

In case of over-performance (performance exceeding the minimum guaranteed), the further savings will be shared between the contractor and the owner according to a pre-defined proportion.

On the contrary, in case of under-performance (performance lower than the minimum guaranteed) the payment of energy consumption will follow a different rule, and the contractor receives a sum proportionally lower than the corresponding amount of the actual energy consumption.

In any case, the contractor will be repaid of the amount declared for the investments made, which will be added to the payment of energy.

This payment method might suggest the opportunity for the contractor to declare for his proposed investments an amount as high as possible. This strategy however could be of no convenience at all, since a high amount of investments means also a high overall price, which results in a low score for the economic part of the proposal, reducing the chance of being awarded the contract.

This methodology should therefore lead to a balanced proposal, and could be improved with two further tools:

- introducing a score related to the coherence between the set of proposed investments and social/behavioural initiatives, and the expected results, closely related to the minimum guaranteed performance;
- introducing a maximum value for specific categories of technological investments.

The diagram represented in Figure 9 actually represents both the evaluation and payment process, and shows that similar levels of energy consumption price can be obtained in different ways.

In case of bid n. 1 there is a very little reduction on the base price of energy, but a higher energy performance (with consequent higher investments and a higher price paid for them).

In case of bid n.2, there is a very low price of energy, and smaller investments. The total price paid will be lower (with a corresponding high economic score) and the level of energy efficiency will be lower, too, but in this case the evaluation criterion will provide a lower score. The overall score of the two offers will be probably similar.

In case of bid n. 3, we have a high level of investments that will lead to correspondingly high levels of minimum guaranteed savings and of energy consumption, and consequently of price paid for energy. The investment repayment will be high, but very high will be the score for minimum guaranteed performance, and an overall reasonable level of expenditure will probably grant the contract awarding.

Furthermore, the different characteristics of electric and thermal energy suggest to foresee two separate evaluation processes for each of the energy carriers, in case the EPIC is related to the improvement of both of them.

The evaluation elements should include the price of maintenance activities, and an evaluation of the corresponding technical proposal as well.

A hypothetical evaluation grid for an EPIC is shown in

Table 3.

Table 3: Elements of evaluation in the EPIC model

Elements		Pts.		
1	Minimum level of guaranteed Thermal **Energy Savings**		70	Technical evaluation parameters
2	Minimum level of guaranteed Electric **Energy Savings**			
3	Coherence between the minimum level of guaranteed Thermal Energy **Savings and the corresponding proposed technological investments and social actions**			
4	Coherence between the minimum level of guaranteed Electric Energy **Savings and the corresponding proposed technological investments and social actions**			
5	Quality of O&M plan			
6	Further CO_2 emission reduction (thanks to increased investments in renewables)			
7	Clarity and completeness of the proposal			
8	Amount of the overall yearly foreseen expenditure (investments and social/behavioural activities are splitted in the number of years of duration of the contract) Electric Thermal O&M		30	Economical evaluation parameters

This upgrade from EPC to EPIC brings out a further complexity related to the execution time of the investments: while for technological investments it is assumed that they will improve energy efficiency as soon as they are made, or at least within a specific period, for social investments, especially for behavioural changes, this is not predictable with reasonable certainty and, furthermore, it is still not clear whether behaviours need a constant motivation activity or they settle in at one stage.

Apart from the provision of an overall score of 30 pts out of 100 for the economic elements, and 70 for the technical part (30 points for the economical part of the bid, by the way, are the maximum allowed by the

Italian legislation, but in other countries with different limits this score could even be higher) there is, intentionally, no specific score foreseen for each evaluation element in this table.

In the economic part of the evaluation, the proportion between the score assigned to electric and to thermal energy should be set according to their economic value and to the expected results. If we started from an already satisfactory level for one of them, it will be reasonable to foresee a lower score for it.

In the same way, the score (technical and economical) awarded to O&M will be proportional to the importance of these activities, both strategic and economical, in the framework of the contract.

Furthermore, the evaluation of coherence should be scored enough to prevent excessively optimistic minimum guaranteed performance.

In this overall context, clarity and completeness of the proposal should not be considered an evaluation element, but an evaluation criterion to be taken in consideration in the evaluation of all the foreseen elements, and particularly to the evaluation elements under n. 3, n. 4, n. 5 and n. 6.

6. The first experience of EPIC at the Province of Treviso

6.1. Background and evolution

The Province of Treviso undertook in the last 20 years an ambitious path for the management of its building stock, thanks to which a big amount of knowledge, expertise and relations have been collected and allow nowadays to test a real model of EPIC.

It all started in 1998, when the property of high school buildings has been transferred to Provinces and, in the case of Treviso, that meant the doubling amount of its building stock, of which a very scarce information, both in quantitative and in qualitative sense, was available. It was then urgent to get more efficient maintenance tools in order to manage the increasing demand of services.

The solution identified was a multi-service procurement, whose main goal was the improvement of maintenance standards and, by the consequence, a more efficient spending capacity.

This first experience (**1st generation of Global Service**) permitted, although with some criticalities due to the use of a new and little known method, to reach some important objectives:

- resolution of the maintenance emergency;
- creation of a first technical register of building stock;
- knowledge of critical points of the building/services system;
- a working group trained to procedural innovation.

The **2nd generation of Global Service** focused on overcoming the critical issues found in the previous period, by structuring a service with the following characteristics:

- flat rate recording of services in order to better control the expense performance;
- an information system based on building components instead of supplier's activities, in order to better monitor activities carried out;
- a user-friendly information system, to guarantee the interaction of users (schools) and their involvement in building management and care.

Through these experiences an accurate analysis of the building use together with a significant renovation programme were carried out, furthermore, important relations with the schools' staff were established which enabled the development a **3rd generation of Global Service** with the direct and active involvement of final users.

In the meantime, the general context had changed and the 3rd generation of GS was developed in a new situation of remarkable reduction of financial resources for local administrations. The new main goal of GS was then <u>cost reduction</u>, maintaining the same maintenance standard, to be realized by:

- energy costs reduction through technological and social interventions;
- a better use of spaces and resources;
- improving relations with users;
- improving the quality of the Informative System.

Thanks to the experience acquired, which created a sound basis to design the 3rd generation of GS, the Province of Treviso went forward with the elaboration of the tender notice, in which it was possible to develop new and innovative elements, such as:

- the official and significant involvement of users in the processes of building management and in the accomplishment of energy saving goals;
- a programme of technological interventions to improve energy performance of buildings;
- the improvement of the tools for the management of school activities carried out in buildings;
- the improvement of the tools for the support of strategic decisions on school buildings;
- the integration, in the technical register, of further information such as bills, rents, licenses of use by external users, etc.

The procurement specifications have been translated in the Green Schools project, which represents the main application tool of the 3rd generation of GS by combining technological and social innovations through the active participation of users and citizens.

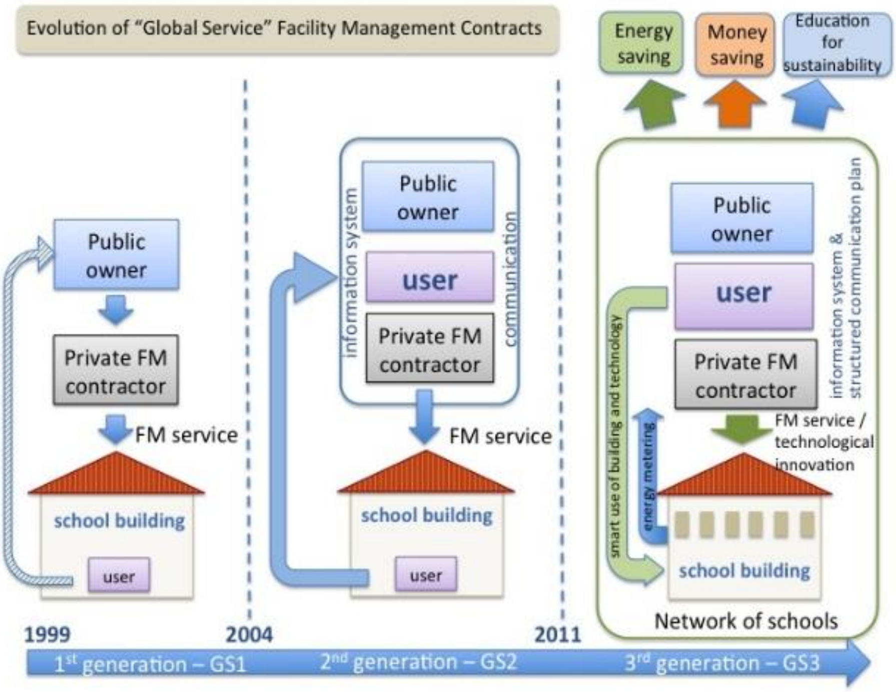


Figure 10: The evolution of Global Service Contract in the Province of Treviso

It must be underlined that the concept of EPIC was not specifically expressed in the 3rd generation of GS: Treviso administration just presented a model of EPC with an additional and general request for the supplier to realize interventions pointed to the involvement of users, without giving precise references. In this framework, the future 4th generation of Global Service will be represented by a real model of EPIC as a further upgrade of this system, with the aim of a continuous improvement of service performance.

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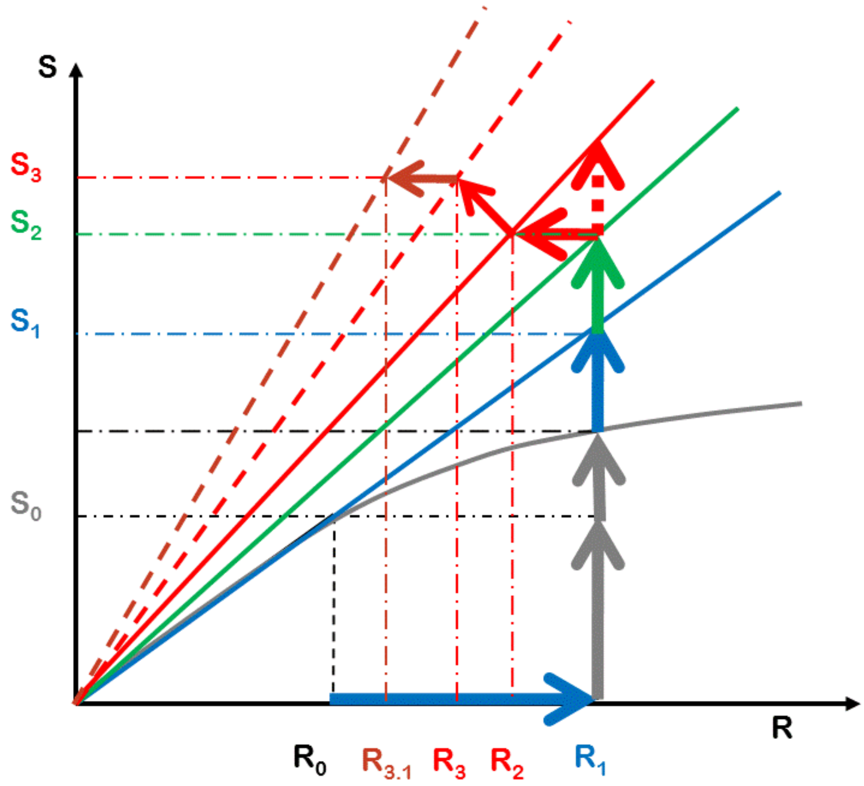


Figure 11: 4th generation of Global Service: improvement of performance by reducing costs (R) and maintaining the quality level of service (S)

6.2. Building investigations

Before starting with planning the EPIC, the Province of Treviso dealt with three issues believed to be fundamental for a successful development of following phases:

- a preliminary energy audit of buildings;
- setting of a baseline as a reference point from which consumption reductions are measured;
- definition of a minimum level of savings that the supplier must obtain.

6.2.1. Energy audit and use analysis

An accurate analysis of energy performance of buildings has been carried out, initially by reading bills, and then conducting energy audits for every building.

Audits have been edited according to the UNI-TS 11300 part 1 and 2 (regarding the definition of building envelope transmittance and plants efficiency) and, when needed, specific analysis with heat-flow meters have been conducted.

A careful investigation on the use of buildings has then been carried out, by examining the actual schedule of use and the actual asset of schoolrooms in each building.

The analysis pointed out a wasteful use of spaces, so that even only by an effective reorganization of the use of spaces and heating times, considerable energy savings could be achieved with no investment costs.

6.2.2. Baseline

The high level of knowledge of plants and managing procedures gained during the 2nd generation of GS allowed to precisely establish a baseline of heating consumption from which the expected performance of the supplier could be calculated. That was the average consumption recorded in seasons 2008/2009 and 2009/2010.

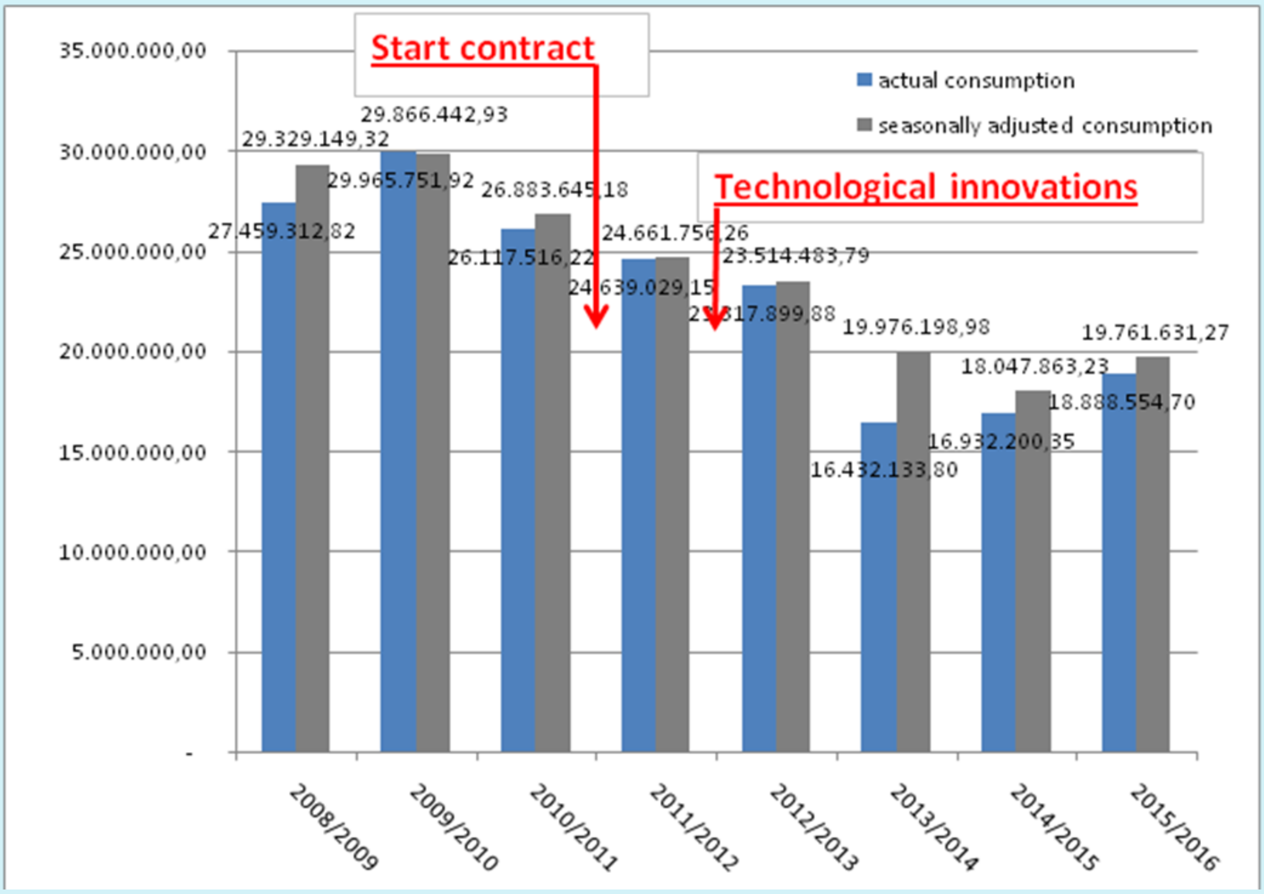
Box 1 - Energy consumption before and after the implementation of the EPIC

The graph below shows the actual heating consumption from 2008/2009 to 2015/2016 in the schools managed through GS (the blue column is the real consumption, while the grey column gives the seasonally adjusted data).

The first two seasons constitute the baseline and the EPIC started after the 3rd season (2010/2011).

It can be noted that a first reduction of energy consumption was already recorded before the implementation of technological innovations (that happened at the end of the 4th season, 2011/2012). That can be explained because the supplier (which was in charge of the 2nd generation of GS too) was already adopting a more efficient use of heating plants, thanks to which some savings had been achieved.

The savings derived from technological innovations started from the 6th season (2013/2014), after the first year of calibration of new systems.



6.2.3. Setting a model of energy improvement

The minimum level of savings to be requested from supplier has been defined through a mathematical model based on energy audits results.

The model was applied firstly for each building and then in an aggregated form for the whole building stock, and some technological interventions have been supposed, according to audits outcomes, taking into account the contract term of 5 years for the payback period.

The lack of reference models led to a “prudent” approach supposing only interventions on plants, by improving production, regulation or distribution efficiency depending on the circumstances.

The result was a minimum level of performance requested of **5% of reduction from baseline** (with the application of penalties in case of lower results) and, in case of better performances, the additional savings would be shared at 50% between PA and the supplier.

A different organization of space use was not taken into account, as it was up to the supplier, through the application of the Communication Plan (see chapter **Napaka! Vira sklicevanja ni bilo mogoče najti.**) the promotion of a more efficient use of buildings.

Table 4: Extract of the model of energy improvement elaborated by the Province of Treviso

	Building 1	Building 2
ACTUAL AVERAGE YEARLY CONSUMPTION (kWh)	493.123,40	306.519,01
AVERAGE YEARLY CONSUMPTION (FROM UNI TS 11300) (kWh)	483.044,24	455.060,19
OVERALL PERFORMANCE	48,7	58,6
REGULATION PERFORMANCE	79,7	81,3
EMISSION PERFORMANCE	88	90
DISTRIBUTION PERFORMANCE	87	90,1
DP improved	95	95
PRODUCTION PERFORMANCE	79,8	89,8
PP improved	95	95
OVERALL PERFORMANCE improved %	63,3	66,04
Cost of interventions	30.000,00	30.000,00
Energy saving %	14,6	7,44
Energy saving (kWh)	71.984,87	22.792,52
Saving/year (€)	6.118,71	1.937,36
Payback Period	5,58	35,9

In this case, only technological interventions have been considered. It is possible to apply the same method to social investments, and this is the main challenge of EPIC: how is it possible to reduce, or even to eliminate, the characteristic uncertainty of social and behavioural interventions? Which parameters and standards can be identified for this kind of actions?

6.3. Technological investments

6.3.1. Technological renovation

In order to achieve the energy efficiency goals requested, the supplier provided for a technological renovation of existing plants, in particular:

- Renewable energy plants:
  - 4 solar thermal systems, A_{tot} = 300 m^2
  - 1 geothermal heat pump
  - 6 photovoltaic systems for a total power of 120 kW
  - 2 cogeneration systems (Pe = 465 kWe Pt = 670 kWt)
- Renovation of existing plants:
  - condensation boilers installed in 19 buildings
  - piping renovation of thermal plants in 17 buildings
  - new thermoregulation systems in 23 buildings
  - conversion to methane in 8 plants
- Instruments for consumption reduction:
  - light reducers
  - 4300 thermostatic valves in 28 buildings
  - 1700 taps with automatic closing.

6.3.2. Energy measurement

The organizational interventions proposed by the supplier were pointed to the monitoring, measurement and the optimization of heat, electric and water consumptions and concerned:

- installation of smart metering for electricity, heating and water;
- use of the Information System for a more efficient use of spaces.

Smart meters were particularly significant in order to involve users, as these devices, in any case were necessary to verify the goals achievement by the supplier, gave to students, teachers and school staff an **immediate feedback of their behaviours** towards energy efficiency, and stimulated them to act always better, in a sort of “good” competition between other classes or schools.

Box 2 – The complexity of a correct smart metering
The installation and implementation of smart meters able to display in real time thermal and electrical consumptions is a complex activity that must be adequately planned. There can be problems relating to the management of the network through which the device sends information, or to the network coverage area. For thermal consumption, the installation of the gauge must be evaluated case by case, which makes the process even more complicated. Those are elements that must be taken into account while implementing an EPIC, as the immediate response of consumption data is important to give users a feedback on their efficient – or not – behaviour. In the case of Treviso, smart meters were not immediately perfectly functioning and reliable, which led to consider **behaviours** (such as organization of events) **more important than results**, and the activities planned from then onwards did not consider the real potential of smart meters. The result was, sometimes, a lacking correspondence between actions implemented and the actual reduction of energy consumptions.

6.4. Social investments

The involvement of final users in schools through social investments has the double purpose of, from one side, making energy savings interventions more efficient thanks to a more aware behaviour of final users, and promoting, on the other side, the importance of sustainability and energy efficiency, which in schools represents an important educational contribution.

The province of Treviso called for the elaboration of a Communication Plan as the main tool to involve users not only in energy saving activities, but more in general in an active participation in the management of school buildings.

The supplier proposed interventions focused both on enhancing behaviours towards consumption reduction (behavioural DSM) and on the optimization of the use of spaces (analytical DSM).

The main social investment to achieve the goals were implementation of the **Green Schools Competition** project: a prize competition aimed to develop a healthy competition among schools, by involving all the stakeholders of public high schools (principals, teachers, students, facility officers, janitors, etc.) and raise awareness on energy saving and environmental sustainability topics.

6.4.1. Definition of the rules of the competition

The Green School Competition, which is now at its 5th edition, is open to all the public high schools of the Province of Treviso and it is based on three different contests:

1. **Consumption reduction**: scores are given based on how many initiatives are implemented, the percentage of energy savings obtained, the smart monitoring of consumptions.
2. **Sharing ideas**: scores are given based on which and how many initiatives are proposed, the realization of a research project based on those proposals, the involvement of teachers and other school staff.
3. **Sustainable coach**: it deals with tutoring activities, which are assessed depending on the number of classes involved, the topics discussed, the involvement of teachers and other school staff, the elaboration of reports by the classes that received the tutoring.

For the three contests the interdisciplinary and divulgation/communication activities (such as files, photos, videos production and their online publication on social networks, webpages, etc.) are also assessed.

Schools can win a single contest or the general contest of Green School competition, which is the total score obtained in all three areas.

In the last edition, the “Energy teams” are awarded too, on the basis of novelty of work, coherence and efficacy of activities, replicability in other contexts.

6.4.2. Designation of the Energy Team and the school Energy Officers

Every school must establish an Energy Team, which represents the working group composed by students and other school staff. The Energy Team must identify a teacher as their representative and manager, who also has to be in charge for communication with the external project team.

The promotion of the Green Schools Competition among schools is assigned to the “Energy officers”. They are teachers that, on a voluntary basis, enliven GSC activities and promote the implementation of virtuous behaviours. Initially there were 6 of them (for all the participating schools) and 2 were added at a later stage only for Treviso and Castelfranco municipalities, which counted a high number of participants. The company in charge of GS provided a reimbursement of 6.000 €/year, which is now used as a further prize money in the competition.

6.4.3. Evaluation and award ceremony

The projects presented are evaluated by a commission, which is elected by the Province of Treviso and it is composed by internal staff and other staff from the local school offices.

Every edition closes with an award ceremony, which is a promotional event for energy saving itself.

6.4.4. Analysis of the results

The technological and social investments implemented led to different levels of consumption reduction in each school, which have been recorded and it is shown in Figure 12.

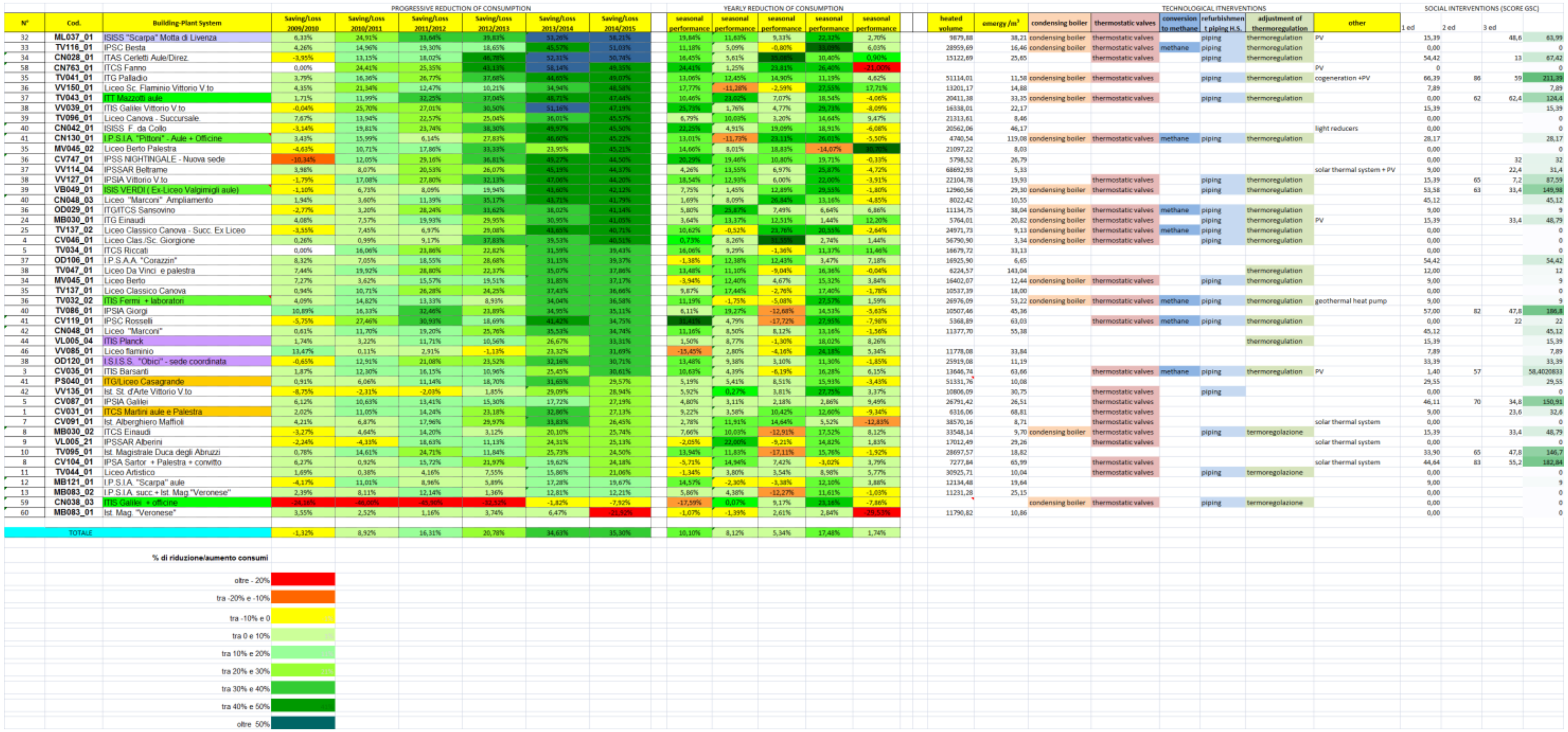


Figure 12: Consumption reduction and interventions implemented

The first three columns refer to the identification of pilot buildings.

N°	Cod.	Building-Plant System
32	ML037_01	ISISS "Scarpa" Motta di Livenza
33	TV116_01	IPSC Besta
34	CN028_01	ITAS Cerletti Aule/Direz.
58	CN763_01	ITCS Fanno
35	TV041_01	ITG Palladio

Figure 13: Identification of pilot buildings

The following 6 columns show the progressive savings/drops of consumption from 2009/2010 to 2014/2015.

PROGRESSIVE REDUCTION OF CONSUMPTION					
Saving/Loss 2009/2010	Saving/Loss 2010/2011	Saving/Loss 2011/2012	Saving/Loss 2012/2013	Saving/Loss 2013/2014	Saving/Loss 2014/2015
6,33%	24,91%	33,64%	39,83%	53,26%	58,21%
4,26%	14,96%	19,30%	18,65%	45,57%	51,03%
-3,95%	13,15%	18,02%	46,78%	52,31%	50,74%
0,00%	24,41%	25,35%	43,13%	58,14%	49,35%
3,79%	16,36%	26,77%	37,68%	44,65%	49,07%

Figure 1: The progressive savings/drops of consumption from 2009/2010 to 2014/2015

While in the next 5 columns it is represented the seasonal performance compared to the previous year.

YEARLY REDUCTION OF CONSUMPTION				
seasonal performance 1011/0910	seasonal performance 1112/1011	seasonal performance 1213/1112	seasonal performance 1314/1213	seasonal performance 1415/1314
19,84%	11,63%	9,33%	22,32%	2,70%
11,18%	5,09%	-0,80%	33,09%	6,03%
16,45%	5,61%	35,08%	10,40%	0,90%
24,41%	1,25%	23,81%	26,40%	-21,00%
13,06%	12,45%	14,90%	11,19%	4,62%

Figure 14: The seasonal performance compared to the previous year

The 5 coloured columns (pink, violet, blue, light blue, green) describe which technological interventions have been implemented in each building.

TECHNOLOGICAL ITNERVENTIONS					
condensing boiler	**thermostatic valves**	**conversion to methane**	**refurbishment piping H.S.**	**adjustment of thermoregulation system**	**other**
condensing boiler	thermostatic valves		piping	thermoregulation	PV
condensing boiler	thermostatic valves	methane	piping	thermoregulation	
	thermostatic valves		piping	thermoregulation	
					PV
condensing boiler	thermostatic valves		piping	thermoregulation	cogeneration +PV

Figure 15: List of implemented technological interventions in each of building

While the last column describes the social interventions developed during the first three editions of the Green Schools Competition.

SOCIAL INTERVENTIONS (SCORE GSC)			
1 ed	2 ed	3 ed	
15,39		48,6	63,99
0,00			0
54,42		13	67,42
0			0
66,39	86	59	211,39

Figure 16: The social interventions developed during the first three editions of the Green Schools Competition

It can be noted that, while there is a correspondence between bigger energy savings and more relevant technological interventions, this link is not so evident for social interventions, which is the weakness emerged in the Green Schools Competition process. This lack of congruence has probably been caused by a wrong interpretation, by the GS Company, of the main tool adopted as social investment: the communication plan directed behavioural interventions mostly to communication and divulgation activities that were not necessarily connected to a real reduction of energy consumption (see box 3).

Box 3 – The Communication Plan: what went wrong

The Communication Plan proposed by the supplier was structured in three sections:

- the container (buildings and service procedures, AR);
- the content (number of students, activities, etc., AC);
- the energy (in terms of consumption, E).

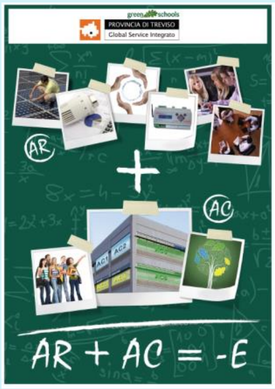
The assumption was that **the sum of technological investments** (regarding the container) **and social investments** (regarding the content) **produced a minor consumption of energy:**

$$AR + AC = - E$$

In the Plan, school is considered as a heritage of the community, and the sense of membership and responsibility is stimulated towards a more aware use and management. In this way, users turns from passive-demanding into active-participative players.

The communication actions foreseen in the Plan were both traditional (flyers, booklets, etc.) and digital (website, social network, etc.).

The lacking point of the Communication Plan, which made it unsuccessful, was that it was not considered a link with an Action Plan on training and educational activities.



6.5. Next steps

The route taken by the Province of Treviso and described so far led to the development of a favourable framework characterized by:

- a “competitive advantage” due to an advanced starting point;
- technological knowledge of the building stock;
- rooted relationships with users;
- tested management procedures;
- an internal staff already trained and oriented to the monitoring of an external supplier instead of a direct management of services.

This allows to plan further improvements and innovations for the **4th generation of Global Service**, which can be detailed in:

- a further improvement of energy performance;
- an increased number of users that participate to innovation;
- a further reduction of management costs;
- the precise definition, in the invitation to tender, of social investment actions, which are no more delegated to the supplier’s discretion;
- creation of a mathematical model associating the activities implemented in the Green School competition, or in other behaviour-based energy efficiency programmes, and the measured energy savings;
- definition of an agreement between Province and schools for focusing and sharing energy savings and elaboration of a Reinvestment Action Plan.

In this framework, the project TOGETHER represents the continuation and upgrade of this experience.

7. Conclusion

This report provides a guideline for those Public Administrations that are willing to experiment a new and innovative type of Energy Service contract for their public buildings, by realizing energy efficiency interventions taking care of all EE facets: technological, organizational and behavioural ones.

If the investment in technological interventions is the most common method to reduce energy consumption, both in public and in private sector, organizational and behavioural interventions are now starting to be considered as relevant aspects for a better achievement of energy efficiency goals: a study of the European Environment Agency demonstrates that behavioural changes can contribute for up to 20% of energy savings in buildings (see Table 5)[14]

Table 5: Potential energy savings due to measures targeting behaviour

Intervention	Range of energy savings
Feedback	5-15%
Direct feedback (including smart meters)	5-15%
Indirect feedback (e.g. enhanced billing)	2-10%
Feedback and target setting	5-15%
Energy audits	5-20%
Community-based initiatives	5-20%
Combination interventions (of more than one)	5-20%

In this way, EPIC is a new type of contractual agreement for energy supply services (maintenance and management) and it can be considered the evolution of classic models of EPC, being a useful financial tool in the hands of Public Administrations that are interested to increase energy savings by the involvement and empowerment of building users.
The experience of the Province of Treviso, presented in the previous chapter, is a good example that shows a possible path to follow to implement an EPIC, considering the necessary procedures, the possible obstacles and the advantages and results that can be achieved.

By analysing Treviso's experience, it is possible to observe how EPIC allows, from one side, the elaboration of an investment plan in which savings are derived from both technological and social (organizational and behavioural) interventions, which means higher savings produced by low cost, or even no cost, social interventions.

14 *Achieving energy efficiency through behaviour change: what does it take?*, EEA technical report n. 5/2013

From the other side, it is not possible to include the benefits derived from behavioural investments in an ordinary financial analysis, as they mostly represent an educational aspect whose results are difficult to account and foresee within a fixed timing.

However, behavioural investments lead to an added value that a Public Administration cannot ignore, which is represented by the educational value and the development of a more aware citizenship that will be able, in the long term, to use buildings and energy in a more efficient and responsible way.

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Glossary

DSM	-	Demand Side Management
EE	-	Energy Efficiency
EPC	-	Energy Performance Contract
EPIC	-	Energy Performance Integrated Contract
ESCo	-	Energy Service Company
ESM	-	Energy Saving Measures
GHG	-	Greenhouse Gas
GSC	-	Green School Competition
NEP	-	Normalized Energy Performance
NPV	-	Net Present Value
PA	-	Public Administration
SSM	-	Supply Side Management

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