CE51 TOGETHER

Transnational Protocol for the definition of the system for calculating savings generated by the pilot actions functional to the Reinvestment Plan

D.T2.2.5

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TOGETHER

TOwards a Goal of Efficiency THrough Energy Reduction

Transnational Protocol for the definition of the system for calculating savings generated by the pilot actions functional to the Reinvestment Plan

D.T2.2.5

PP3 - University of Maribor

Executive summary

This document represents the deliverable T2.2.5 – a Transnational Protocol for the definition of the system calculating the savings generated by the pilot actions, functional to the Reinvestment Plan. The idea is to help partners with the procedure, methodology or protocol on how to collect, analyse the data for calculating savings.

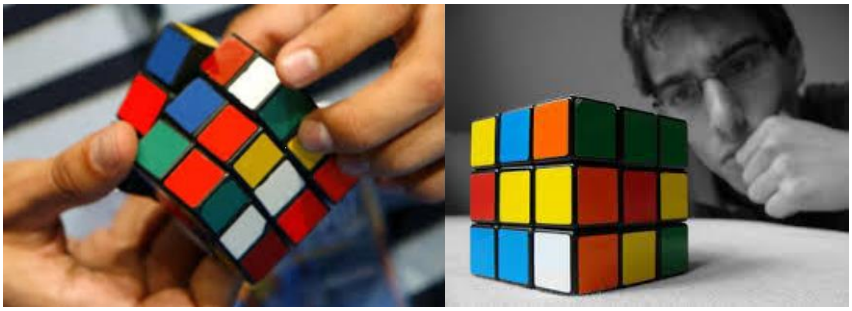
Estimating the energy impacts from energy efficiency and renewable energy policies and programs is a critical evaluation step that enables calculation of other benefits, such as reductions in greenhouse gases, air pollutants, and electricity demand. How this is done depends on whether the effort being evaluated aims to increase clean energy supply or reduce energy demand (i.e., energy efficiency).

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 tools 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, and 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 Transnational protocol

This document represents the deliverable T2.2.5 – Transnational Protocol for the definition of the system calculating the savings generated by the pilot actions, functional to the Reinvestment Plan. The protocol is linked to the Common Protocol (D.T2.1.1) containing technical guidelines for savings measurement and verification and will allow a benchmarking of the piloting systems.

1.3. Usage of Transnational protocol

The conceptual challenge, which exists is that the energy savings are calculated as the difference between "real" actual measurements, taken, and "estimated" values that would have been measured during the post-retrofit period, as the "business as usual" values. However, with the equipment partners will be able to carry out accurate measurements of the energy consumption.

2. General data of the system under supervision

This section is gathering the general data about the facilities or buildings under the supervision (pilot buildings considered within the project).

2.1. Name of the facility, address and a contact person

Within this section each partner should provide all the info about their facilities, and number them starting with No. 1. The required information in this section are: number of the facility, name/title of the facility (e.g. municipality building or dormitory No. 6, etc.), address of the facility and a contact person (a person responsible for the maintenance of this facility, e.g. energy manager, administrative staff of the municipality).

Table 1: Required information about the facility

Facility No.	Address	Responsible person (name, telephone number and an email)
1.		
2.		
Etc.		

2.2. Data about the facility

Under this section, partner will provide a more detailed information about their facilities (e.g. year of construction, year of renovation, no. of users, etc.) – see the table below. If they have more facilities under supervision, partner need to copy as many tables as required to fill in the data of all the facilities.

Table 2: Data about the facility (if there is more than one facility, please add more tables)

Year of construction	
Year of renovation	
- *Year of renovation of boiler room*	
- *Year of renovation of lighting*	
- *Year of renovation of other (specify)_____*	
No. of users of the facility	
No. of floors	
Height of floors	

Surface of the building envelop	
Gross volume of the building	
Surface to volume ratio	
Net usable area of the buildings	
Air change rate (ACH)	
Annual heat demand (kWh/a)	
Type of heating	
Renewable enery sources. If yes, which _____	

2.3. Timetable of the occupancy during summer and winter seasons

Under this section, partners need to provide the info about the occupancy for each season of the year for each facility, due the fact that occupancy for various facilities differ if we consider e.g. a museum or a dormitory.

Table 3: Timetable of the occupancy during summer and winter seasons (if there is more than one facility, please add more tables)

	Occupied from e.g. 8.00 – 15.00	Hours (e.g. occupied for 7 hours)
Weekdays from to		
Saturdays from to		
Sundays from to		
Other, please specify _____		

2.4. Planned changes of the facility

2.4.1. Technological changes

Planned changes of the facility regarding energy consumption and energy efficiency. Please provide information of planned changes, such as improvement of the internal lightings (including detailed data), etc., for each facility you will include into your pilots.

2.4.2. Analytical DSM implementation

Under this section partners should provide a structured text in indents (max. 500 characters), about the implementation of the analytical DSM in their facilities (e.g. reading energy bills, energy meters, analysing the energy consumption data, ICT solutions used for optimisation, etc.).

2.4.3. Behavioural changes

Under this section partners should provide a structured text in indents (max. 500 characters), about the behavioural changes in their facilities (e.g. communication with users, activities for behavioural changes, tools for motivating users for more efficient energy usage or low-cost savings, etc.). If partners did not carried out any mentioned activities, then they should explain in this section their future activities.

2.5. Energy Consumption Data

In this section, partners are asked to fill in the energy consumption data for each facility considered within the project. 2016 was considered as a baseline year.

Table 4: Energy consumption data (if there is more than one facility, please add more tables)

Data about the annual energy usage				2016 (baseline year)		
Energy source		Unit	Calorific value	The amount of energy spent kWh	Energy input kWh	Costs in €
Electricity	Heating	kWh				
	Cooling	kWh				
	Ventilation	kWh				
	Lighting	kWh				
	Other	kWh				
	TOTAL Electricity	kWh			-	
Fuel	Extra light fuel oil	l		-	-	-
	Natural gas	m3		-	-	-
	Liquefied natural gas	m3		-	-	-
	Biomass	kg		-	-	-
	District heating	kWh		-	-	-
	Other				-	

In this section, partners are asked to fill in the historic energy consumption data (years 2014, 2015, and 2016) for each facility considered within the project, showing the consumption per month, including monetary units. If data cannot be obtained or calculated on a monthly basis, then partners should provide the data on the annual basis.

Table 5: Historical energy consumption data (if there is more than one facility, please add more tables)

	2014				2015				2016			
	Energy source		Electricity		Energy source		Electricity		Energy source		Electricity	
Month	kWh	EUR/a	kWh/a	EUR/a	kWh	EUR/a	kWh/a	EUR/a	kWh	EUR/a	kWh/a	EUR/a
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

Table 6: Construction and heating data (if there is more than one facility, please add more tables)

Envelope (facade)

External construction (walls, floor, ...)	A	B	C	D	**Total**
Thickness in cm					
Heat transfer W/m2K					
Surface in m2					

Roof

	A	B	C	D	**Total**
Thickness in cm					
Heat transfer W/m2K					
Surface in m2					

Floor

	A	B	C	D	**Total**
Thickness in cm					
Heat transfer W/m2K					
Surface in m2					

Windows	A	B	C	D	**Total**
Heat transfer W/m2K					
Surface in m2					
Blinds YES/NO					

Doors	A	B	C	D	**Total**
Heat transfer W/m2K					
Surface in m2					

Insulation of ground floor		
Insulation of roof		
Thermal bridges		

Main deficiencies	

B. Energy supply

Which energy sources are used	

Co-supply from other buildings	YES	

		NO	

Heating system

	Connection power		kW
	Inlet water T		°C
	Outlet water T		°C
	Number of heating loops		
	Regulation		
	Insulation of pipelines		
	Thermostats	YES	
		NO	
	Central control system	YES	
		NO	
	Central ventilation	YES	
		NO	
	Heat recovery	YES	
		NO	
	Heaters	e.g. radiators	

Hot water

	Central preparation of hot water	YES	
		NO	
	Usage of HW per month		L
	Main consumers of HW		
	Insulation of pipes		

Table 7: Electricity users and consumers (if there is more than one facility, please add more tables)

I. Lighting	W/a	Number	h/day	days/year	Total kWh
FLUO					-
CFL					-
LED					-
Other					-
TOTAL					-

II. Preparation of hot sanitary water	W/a	Number	h/day	days/year	Total kWh
Electricity heater					-
Other					-
					-
					-
TOTAL					-

III. Cooling	W/a	Number	h/day	days/year	Total kWh
					-
					-
					-
					-
TOTAL					-

IV. Electricity heaters	W/a	Number	h/day	days/year	Total kWh
Electric radiator					-
Other					-
					-
					-
TOTAL					-

V. Heating	W/a	Number	h/day	days/year	Total kWh
					-
					-
					-
					-
TOTAL					-

VI. Air-conditioning	W/a	Number	h/day	days/year	Total kWh
					-
					-
					-
					-
TOTAL					-

VII. Ventilation	W/a	Number	h/day	days/year	Total kWh
					-
					-
					-
					-
TOTAL					-

VIII. IT technology	W/a	Number	h/day	days/year	Total kWh
					-
					-
					-
					-
TOTAL					-

IX. Kitchen	W/a	Number	h/day	days/year	Total kWh
					-
					-
					-
					-
TOTAL					-

X. Other	W/a	Number	h/day	days/year	Total kWh
Washing machine					-
Copy machine					-
Fridge					-
Etc.					-
					-
					-
TOTAL					-

2.6. Definition of equipment and systems used for heating, cooling, collecting and distributing energy

Under this section, partners should provide a structured text in indents (max. 500 characters), about their equipment and systems, used for heating, cooling, collecting and distributing the energy for their facilities.

2.7. Identification of smart metering and/or smart systems (if existing)

Under this section, partners should provide a structured text in indents (max. 500 characters), about their smart metering system (if existing).

2.8. Users profiles

In this section, partners should provide a structured text in indents (max. 500 characters) about the users of the facilities. Partners should define the number and the profile of the users in the pilot buildings, per pilot if there are differences (e.g. if the systems consists only of dormitories, there will be no difference between the profiles of the users).

2.9. Already existing experiences of users involvement in the energy reduction

In this section, partners should provide a structured text in indents (max. 500 characters) if they already have some previous experiences (also projects) regarding the involvement of the facilities' users in the energy efficiency, decrease of energy consumption, such as behavioural changes and briefly describe the positive and/or negative issues of their previous experiences.

3. Energy savings calculations[1]

The quality and credibility of reported savings is affected by the selection, execution and documentation calculation methods used. Usually energy measurements are obtained using physical meters and instruments.

The computational methods used to calculate Baseline Energy values use mathematical estimation techniques and algorithms ranging from relatively simple to relatively complex. The quality and credibility of the calculated savings depend mainly on:

- The appropriateness of the selected computational method.
- The knowledge, skills and experience of those responsible for calculating the savings.
- The discipline and transparency of the computational processes.
- The handling of uncertainties in the available data and those inherent in the selected computational process.

Statistical methods are used for some of the computational methods and for estimating uncertainty in the reported savings.

During the partners' meetings in Zagreb partners decided to consider the option C (for the reference please see D.T2.1.1.), a whole facility approach, which is according to the IPMVP best for managing and reporting overall facility energy performance and greenhouse as abatement. It is expected that partners will have available monthly facility billing data and the availability to get the weather data from the meteorology or statistical office. Furthermore, partners should have available administrative/operational records to identify changes.

Steps to carry out savings:

- STEP 1: to evaluate the existing policies, procedures, processes and collecting and analyses of the data (our common goal is to reach 20% of reduction in energy consumption), please see also Tables 1-5 of this document. It is important that the historical data are complete and have a sufficient quality.
- STEP 2: to compare the monthly energy consumption data to highly year-to-year monthly seasonal differences. Due to the heating season, differences are expected between heating and non-heating seasons.
- STEP 3: to examine the variations (correlations) of the energy consumption data with the weather data (e.g. daily high and low temperatures)
- STEP 4: calculating the cooling degree days (CDD), relative to the standard balance point 18,3°C and compare to year-to-year differences (month-to-month, depends on the data)
- STEP 5: determination of the method to find out a statistically valid Baseline model (including a relationship between consumption and weather conditions). The IPMVP suggests a linear regression between monthly energy consumption data and the weather for the base reference year(s).
- STEP 6: reporting the consumption of energy using smart meters.
- STEP 7: calculating savings: EPA[2] (Environmental Protection Agency) suggesting several calculation options:

[1] Fort he reference please see the IPMVP.

[2] Please see the link: https://www.epa.gov/statelocalclimate/calculating-energy-savings

- Statistical analyses: Statistical models are used to estimate “before” and “after” scenarios, while taking into consideration changes in weather, facility occupancy, factory operating hours, and other factors that affect energy use.
- Metering and Monitoring: Baseline and post-installation energy use is directly metered and monitored, while accounting for the non-energy factors that affect energy consumption.

Savings are usually calculated as:

*Energy savings = **(b)**(Baseline energy use) — **(a)**(Post-installation energy use)*

- STEP 8: benchmarking – it has 2 main purposes: a) to identify facility's performance (“ex-ante and ex-post” evaluations); b) to identify potential savings shown as a variance between the actual data. Since we will have installed equipment it is expected that we will have actual models.

4. How to convert energy savings into monetary savings

4.1. Electricity

Monetary savings of electricity (in EUR) = [consumption (in kWh) before intervention (investment or behavioural changes of users or both) – consumption (in kWh) after intervention] * cost of kWh in EUR.

4.2. Heating

Monetary savings of energy used for heating (in EUR) = [consumption (in kWh) before intervention (investment or behavioural changes of users or both) – consumption (in kWh) after intervention] * cost of kWh in EUR.

4.3. Cooling

Monetary savings of energy used for cooling (in kWh) = [consumption (in kWh) before intervention (investment or behavioural changes of users or both) – consumption (in kWh) after intervention] * cost of kWh in EUR.

5. Conclusion

This document represents the deliverable T2.2.5, entitled A Transnational Protocol for the definition for the system calculating the savings, generated by the pilot actions, functional to the Reinvestment Plan. The document represents a procedure about gathering data of the pilot facilities (such as general data about the facility, timetable of the occupancy, planned changes at the facility, analytical DMS implementation …) as well as energy consumption data and energy savings calculations. Consortia of the TOGETHER project designed this document in order to help partners with the procedure, methodology and protocol on how to collect and analyse the data for calculating energy savings.

References

Glossary

CAD	-	Computer Aided Design
ISO	-	International Standard Organisation
FE	-	Faculty of Energy Technology
EE	-	Energy Efficiency
EPIC	-	Energy Performance Integrated Contract
ACH	-	Air change rate
DSM	-	Demand Side Management
FLUO	-	Fluorescent lamp or tube
CFL	-	Compact fluorescent lamp
LED	-	Light-emitting diode
IPMVP	-	International Performance Measurement and Verification Protocol
EPA	-	Environmental Protection Agency

List of Tables

Appendix