CE51 TOGETHER

Transnacionalni protokol definiranja sustava za izračun ušteda generiranih pilot-mjerama koje funkcioniraju za plan ponovnog ulaganja 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

Izvršni sažetak

U ovom dokumentu predstavljen je rezultat T.2.2.5. – Transnacionalni protokol definiranja sustava za izračun ušteda generiranih pilot-mjerama koje funkcioniraju za plan ponovnog ulaganja. Ideja je pomoći partnerima s postupkom, metodologijom ili protokolom o tome kako prikupljati i analizirati podatke za izračun uštede.

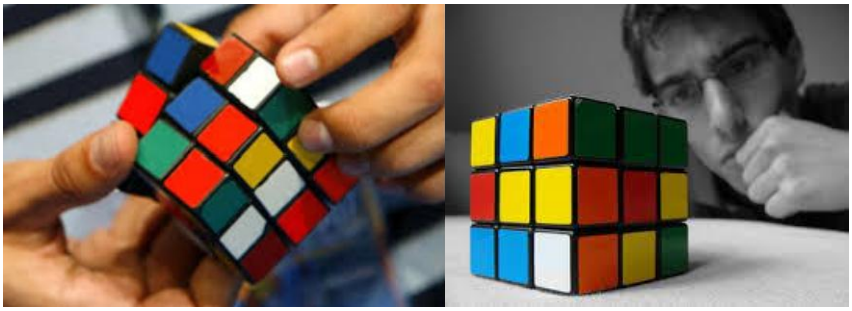
Procjenjivanje energetskih učinaka iz politika i programa o energetskoj učinkovitosti i obnovljivoj energiji ključan je evaluacijski korak koji omogućuje izračun ostalih prednosti poput smanjena stakleničkih plinova, onečišćivača zraka i potrošnje za strujom. Način na koji se navedeno provodi ovisi o tome je li nastojanje koje se evaluira usmjereno povećanju opskrbe čistom energijom ili smanjenju energetske potražnje (tj. energetskoj učinkovitosti).

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. Opći podatci o sustavu koji se nadgleda

U ovom se odjeljku prikupljaju opći podatci o objektima ili zgradama koje se nadgledaju (koje se u sklopu projekta smatraju pilot-zgradama).

2.1. Naziv objekta, adresa i osoba za kontakt

U ovom odjeljku svaki partner treba navesti sve informacije o svojim objektima te ih obrojčati, počevši s brojem 1. U ovom se odjeljku traže sljedeće informacije: broj objekta, naziv objekta (npr. općinska zgrada ili studentski dom br. 6. itd.), adresa objekta i osoba za kontakt (osoba odgovorna za održavanje tog objekta, npr. energetski upravitelj, administrativno osoblje općine).

Tablica 1: Potrebne informacije o objektu

Br. objekta	Adresa	Odgovorna osoba (ime, telefonski broj i e-pošta)
1.		
2.		
itd.		

2.2. Podatci o objektu

U ovom će odjeljku partner navesti detaljnije informacije o svojim objektima (npr. godinu izgradnje, godinu obnove, broj korisnika itd.) – vidjeti tablicu u nastavku. Ako nadgleda više objekata, parter treba kopirati onoliko tablica koliko mu je potrebno da bi popunio podatke o svim objektima.

Tablica 2: Podatci o objektu (ako je riječ o više od jednog objekta, dodajte još tablica)

Godina izgradnje	
Godina obnove	
- *Godina obnove kotlovnice*	
- *Godina obnove rasvjete*	
- *Godina obnove drugoga (navesti)_____*	
Br. korisnika zgradom	
Br. katova	
Visina katova	
Površina fasade zgrade	

Bruto obujam zgrade	
Omjer površine prema obujmu	
Neto iskoristive površine zgrada	
Stopa izmjene zraka (ACH)	
Godišnja potrošnja toplinske energije (kWh/a)	
Vrsta grijanja	
Obnovljivi izvori energije Ako da, koji _____	

2.1. Vremenski okvir zauzetosti tijekom ljetne i zimske sezone

U ovom odjeljku partneri trebaju pružiti informacije o zauzetosti za svako doba godine za svaki objekt, a zbog činjenice da se zauzetost različitih objekata razlikuje ako, primjerice, u obzir uzmemo muzej ili studentski dom.

Tablica 3: Vremenski okvir zauzetosti tijekom ljetne i zimske sezone (ako postoji više od jednog objekta, dodajte još tablica)

	Zauzeta od, npr., 8.00 – 15.00	Sati (npr. zauzeta 7 sati)
Radnim danima od do		
Subotama od do		
Nedjeljama od do		
Ostalo, navesti _____		

2.2. Planirane promjene objekta

2.2.1. Tehnološke promjene

Planirane promjene objekta u pogledu potrošnje energije i energetske učinkovitosti. Navedite informacije o planiranim promjenama, npr. poboljšanje interne rasvjete (uključujući detaljne podatke) itd. za svaki objekt koji će biti uključen u vaš pilot-projekt.

2.2.2. Provedba analitičkog DSM-a

U ovom odjeljku partneri trebaju navesti oblikovani tekst s uvlakama (maks. 500 znakova) o provedbi analitičkog DSM-a u svojim objektima (npr. očitanje energetskih računa, energetski mjerači, analiziranje podataka potrošnje energije, IKT rješenja kojima se koristi za optimizaciju itd.).

2.2.3. Bihevioralne promjene

U ovom odjeljku partneri trebaju navesti oblikovani tekst s uvlakama (maks. 500 znakova) o bihevioralnim promjenama u svojim objektima (npr. komunikacija s korisnicima, aktivnosti za bihevioralne promjene, alati za motiviranje korisnika na učinkovitiju upotrebu energije ili jeftine uštede itd.). Ako parteri nisu proveli nijednu od spomenutih aktivnosti, tada u ovom odjeljku trebaju objasniti svoje buduće aktivnosti.

2.3. Podatci o potrošnji energije

U ovom se odjeljku od partnera traži da popune podatke o potrošnji energije za svaki objekt koji se u projektu razmatra. Polazišnom godinom smatra se 2016.

Tablica 4: Podatci o potrošnji energije (ako je riječ o više od jednog objekta, dodajte još tablica)

Podatci o godišnjem korištenju energije				2016. (polazišna godina)		
Izvor energije		Jedinica	Kalorijska vrijednost	Iznos utrošene energije kWh	Unos energije kWh	Troškovi u €
Struja	Grijanje	kWh				
	Hlađenje	kWh				
	Ventilacija	kWh				
	Rasvjeta	kWh				
	Ostalo	kWh				
	UKUPNO struje	kWh			-	
Gorivo	Ekstralako loživo ulje	l		-	-	-
	Prirodni plin	m3		-	-	-
	Ukapljeni prirodni plin	m3		-	-	-
	Biomasa	kg		-	-	-
	Grijanje okruga	kWh		-	-	-
	Ostalo				-	

U ovom se odjeljku od partnera traži da popune podatke o prethodnoj potrošnji energije (za godine 2014., 2015. i 2016.) za svaki objekt koji se u projektu razmatra, prikazujući potrošnju po mjesecu i uključujući novčane jedinice. Ako partneri ne mogu dobiti ili izračunati podatke na mjesečnoj osnovi, trebaju navesti podatke na godišnjoj razini.

Tablica 5: Podatci o prethodnoj potrošnji energije (ako je riječ o više od jednog objekta, dodajte još tablica)

	2014.				2015.				2016.			
	Izvor energije		Struja		Izvor energije		Struja		Izvor energije		Struja	
Mjesec	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.												

Tablica 6: Podatci o konstrukciji i grijanju (ako je riječ o više od jednog objekta, dodajte još tablica)

Pročelje

Vanjska konstrukcija (zidovi, pod,..)	A	B	C	D	**Ukupno**
Debljina u cm					
Prijenos topline W/m2K					
Površina u m2					

Krov

	A	B	C	D	**Ukupno**
Debljina u cm					
Prijenos topline W/m2K					
Površina u m2					

Pod

	A	B	C	D	**Ukupno**
Debljina u cm					
Prijenos topline W/m2K					
Površina u m2					

Prozori	A	B	C	D	**Ukupno**
Prijenos topline W/m2K					
Površina u m2					
Rolete DA/NE					

Vrata	A	B	C	D	**Ukupno**
Prijenos topline W/m2K					
Površina u m2					

Izolacija na prizemlju		
Izolacija krova		
Termalni mostovi		

Glavni nedostatci	

B. Opskrba energijom

Koji se izvori energije upotrebljavaju	

Dodatna opskrba iz drugih zgrada	DA	

	NE		

Sustav grijanja

Priključna snaga			kW
T ulazne vode			°C
T izlazne vode			°C
Broj petlji grijanja			
Regulacija			
Izolacija cijevi			
Termostati	DA		
	NE		
Središnji kontrolni sustav	DA		
	NE		
Središnja ventilacija	DA		
	NE		
Povrat topline	DA		
	NE		
Grijaća tijela		npr. radijatori	

Topla voda

Središnja priprema tople vode	DA		
	NE		
Korištenje TP mjesečno			l
Glavni potrošači TV			
Izolacija cijevi			

Tablica 7: Korisnici i potrošači struje (ako je riječ o više od jednog objekta, dodajte još tablica)

I. Rasvjeta	W/a	broj	h/dan	dani/godina	Ukupno kWh
FLUO					-
CFL					-
LED					-
Ostalo					-
UKUPNO					-

II. Priprema tople sanitarne vode	W/a	broj	h/dan	dani/godina	Ukupno kWh
Električni grijač					-
Ostalo					-
					-
					-
UKUPNO					-

III. Hlađenje	W/a	broj	h/dan	dani/godina	Ukupno kWh
					-
					-
					-
					-
UKUPNO					-

IV. Električni grijači	W/a	broj	h/dan	dani/godina	Ukupno kWh
Električni radijator					-
Ostalo					-
					-
					-
UKUPNO					-

V. Grijanje	W/a	broj	h/dan	dani/godina	Ukupno kWh
					-
					-
					-
					-
UKUPNO					-

VI. Klimatizacija	W/a	broj	h/dan	dani/godina	Ukupno kWh
					-
					-
					-
					-
UKUPNO					-

VII. Ventilacija	W/a	broj	h/dan	dani/godina	Ukupno kWh
					-
					-
					-
					-
UKUPNO					-

VIII. IT tehnologija	W/a	broj	h/dan	dani/godina	Ukupno kWh
					-
					-
					-
					-
UKUPNO					-

IX. Kuhinja	W/a	broj	h/dan	dani/godina	Ukupno kWh
					-
					-
					-
					-
UKUPNO					-

X. Ostalo	W/a	broj	h/dan	dani/godina	Ukupno kWh
Perilica					-
Uređaj za kopiranje					-
Hladnjak					-
itd.					-
					-
					-

UKUPNO					-

2.4. Definiranje opreme i sustava koji se upotrebljavaju za grijanje, hlađenje, prikupljanje i distribuiranje energije

U ovom odjeljku partneri trebaju navesti oblikovani tekst s uvlakama (maks. 500 znakova) o svojoj opremi i sustavima koje upotrebljavaju za grijanje, hlađenje, prikupljanje i distribuiranje energije u svojim objektima.

2.5. Utvrđivanje pametnog mjerenja i/ili pametnih sustava (ako postoje)

U ovom odjeljku partneri trebaju navesti oblikovani tekst s uvlakama (maks. 500 znakova) o svojim sustavima pametnog mjerenja (ako postoje).

2.6. Profili korisnika

U ovom odjeljku partneri trebaju navesti oblikovani tekst s uvlakama (maks. 500 znakova) o korisnicima objektima. Parteri bi trebali definirati broj i profil korisnika u pilot-zgradama, po pilot-zgradi ako postoje razlike (npr. ako se sustavi sastoje samo od studentskih domova, neće biti razlike u profilu korisnika).

2.7. Već postojeća iskustva uključenosti korisnika u smanjenje energije

U ovom odjeljku partneri trebaju navesti oblikovani tekst s uvlakama (maks. 500 znakova) ako već imaju prethodnih iskustava (ili sudjelovanja u projektima) u vezi s uključivanjem korisnika objektom i energetsku učinkovitost, smanjenje potrošnje energije kao što su bihevioralne promjene te ukratko opisati pozitivne i/ili negativne strane prethodnih iskustava.

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