SUBSTANTIATION TO IMPROVE ENERGY EFFICIENCY PLATFORM FOR A TOURISM COMPANY

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Summary – This article is structured in three parts. The first part is justifying the utility of developing PIEE, in the light of legal requirements, by companies that consume at least 1000 toe/year, but also in the light of the usefulness of PIEE in increasing both energy and economic efficiency of the organizations concerned. The second part contains a methodology of analysis and a synthesis of the specifications on the energy consumption of the TC and energy performance indicator of these. Internal (between S-TC) and external (other TC) comparisons enable to identify the development potential of ENEF for the TC analyzed. The last part of the article represents the conclusions of the analysis.

Keywords: energy efficiency, tourism, program, indicators

1. INTRODUCTION

The reduction of the greenhouse effect required the establishment of international commitments [1, 2] and taking on strategies for sustainable development (SD) [3, 4], with concrete targets on reducing energy consumptions from fossil fuels – the main cause of greenhouse gas emissions. An essential way of realization of SD is by increasing the efficiency of the energy conversion processes.

The latest EU regulation on energy efficiency (ENEF) is Directive 2012/27/EC [5], adopted in Romania by Law 121/2014 [6] and supplemented by Law 160/2016 [7]. The strategic objective undertaken at EU level by Directive 2006/32/EC on the reduction of primary energy consumption with 20% [5, 6, 8] is materialized by an energy saving of 1.5%/year – by volume of sales to final consumers.

Additionally, in Romania Law 372/2005 is in force – concerning energy performance of buildings [9] and the National Action Plan-on ENEF, updated by the Government Decision no. 122/2015 [10] reaffirming the national target for ENEF 2020: achieving a 10 million of toe energy economy, compared to projections for 2007. The emphasis put on the increase of ENEF of buildings is justified on the basis of the estimated efficiency potential (fig. 1), as well as on the basis of economic efficiency and technical facilities of energy efficiency works in buildings.

Tourism is an important branch of the industry, which, on the other hand, has a significant number of buildings (hotels etc.). This indicates the importance of increasing the ENEF of tourism companies. Hotels are an essential part of the tourism industry and are among the top five types of buildings in the service sector on energy consumption.

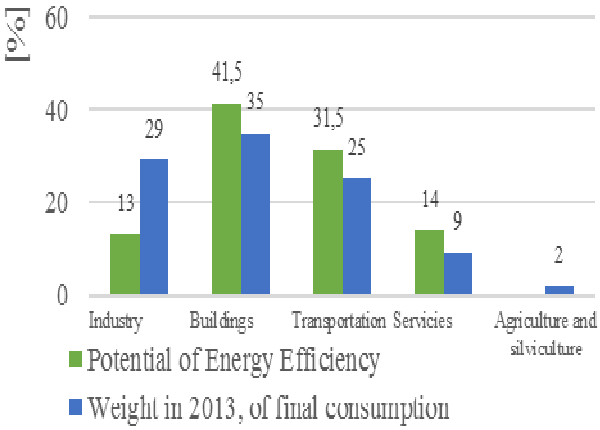

Fig. 1. Potential of ENEF [10]

In a hotel, the energy consumption can be divided into three main areas:

- rooms (bedroom, bathroom etc.) – the consumed energy is variable;
- public area (reception, hallways, restaurant, bar, conference room etc.) – high power consumption, high heat loss;
- service area (kitchen, laundry, utility room etc.) – is the most dependent area of energy, high consumption of electricity;

The power consumption of these categories is very different [11].

A common hotel annually consumes around 320 kW/m2 and releases between 120 – 200 kg of CO2/mp of the floor area [12]. ENEF in the hotel sector should be improved constantly. In accordance with [6], the companies consuming more than 1000 toe/year are liable for elaborating an ENEF platform, according to a model established by ANRE [13]. Since the tourism companies (TC) – a branch of the industry - have an energy consumption profile similar to that of the municipalities, when developing a platform for improving energy efficiency (PIEE) it is necessary to consider the pattern of PIEE for municipalities too [14].

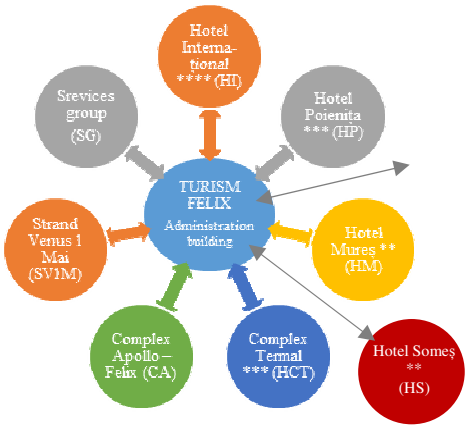

Fig. 2. Structure of TF [15] (HU and HS doesn't working)

This writing deals with methodological and applicatory aspects regarding the substantiation of PIEE for TC (PIEE-CT), considering the peculiarities of these significant consumers of thermal energy (TE), electricity (EE), liquid fuels (LF). The realization of the analysis is done within SC Turism Felix SA (TF), a representative TC in Romania, which owns 7 hotels, 2 spas, administration building and services group (fig.2).

2. SUMMARY OF THE CURRENT SITUATION OF ENERGY CONSUMPTION

According to [11, 12], in this chapter we will make reference to the following aspects:

- Recent evolution of energy consumption by type of energy, sources, subunits, installation and equipment;
- Recent evolution of the value of service (V_S) and value of energy consumption (V_E) at the TC level;
- Evolution and share (P) in V_S of V_E and energy intensity (I_W) at the TC level and subunits (S-TC);
- Specific energy consumption in buildings (C_{SW});
- Comparative analyses between S-TC and TC and between other TC or branch of industry to which it belongs.

The above-mentioned indicators (W_E, I_W, C_{SW}) are calculated with the following:

$$P = \frac{V_E}{V_S} 100 \quad [\%] \qquad (1)$$

$$I_w = \frac{W_C}{V_S} \quad \left[\frac{toe}{Klei}\right] \qquad (2)$$

$$C_{sw} = \frac{W_{CC}}{S} \quad \left[\frac{kWh}{m2}\right] \qquad (3)$$

where,

(V_E, V_S) – value of energy consumption (V_E) and service (V_S) [Klei];

W_C – value of total energy consumption [toe];

W_{CC} – value of total energy consumption at the level of the building [kWh];

S – effective area of the building [m2];

Assessments are made for one year, so the values are annual values. The following presents some results from the TF. TF uses the following forms of energy: EE, TE, and energy of LF, petrol, diesel and recycled fuel oil .

2.1. Energy consumption

a) Electricity (EE)

EE is taken from the National Energy System (NES), from 9 substations [14, 15]. The EE supplier is SC Repower Furnizare Romania SRL. S-TF has separate power measuring devices that make possible the energy management for each subunit. The recent development of EE at the level of TF is presented in fig. 3. The load curve of EE and the evolution price of EE for 2013, 2014 and 2015 are represented in fig. 4 and 5. The price of electricity in the past 3 years has decreased by approximately 0.12 lei/kWh. The recent evolution of EE consumption in the most important S-TF is represented in fig. 6 ÷ 8.

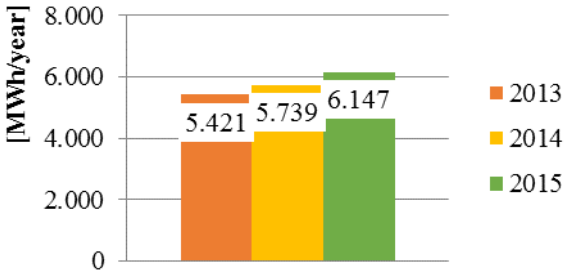

Fig. 3. Evolution of total EE consumption at the TF level

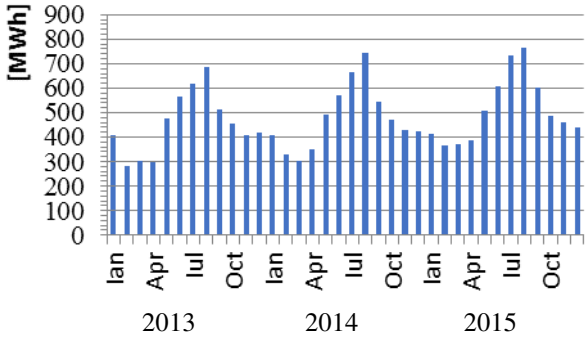

Fig. 4. Load curve of EE, at the TF level

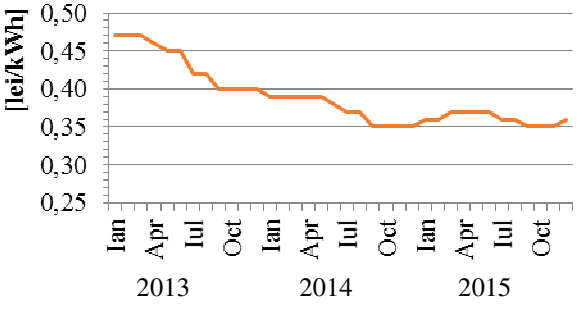

Fig. 5. Evolution of EE price in the past 3 years, at the TF level

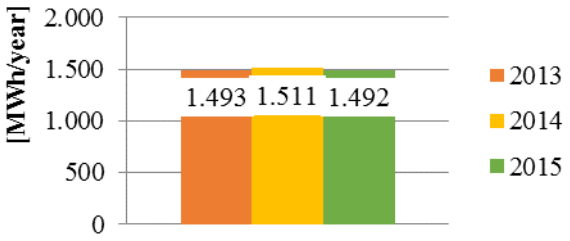

Fig. 6. Evolution of EE consumption for HI

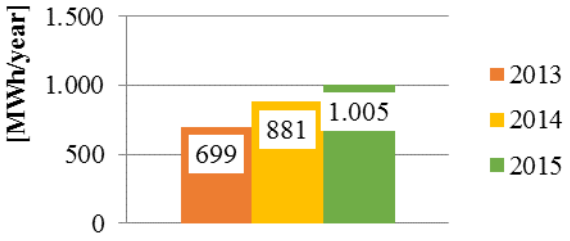

Fig. 7. Evolution of EE consumption for CT

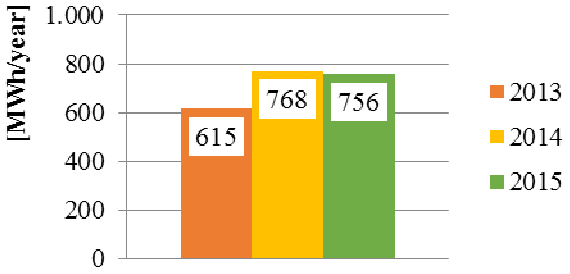

Fig. 8. Evolution of EE consumption for CA

b) Thermal energy (TE)

TE is used for heating and for domestic hot water supply in all S-TF. The TE supplier is SC Termoficare Oradea SA, which also owns the heating network in Băile Felix resort. The TE is metered both, at the input and output of the shape. There is also a metering system for all S-TF, as well as for the tourism sectors for which TF provides TE from its own heating network, having the attribute of sub-distributor. Therefore, there is a possibility for TE to operate on consumer units. If the supplier is unable to ensure the TE, the TE is produced by an own heating system, with 6 MW power, functioning with recycled fuel oil. The diagram of the TE balance sheet for 2015 is illustrated in fig. 9, where:

W_{Ti} [Gcal] – TE provided by Termoficare Oradea;
W_{Tp} [Gcal] – TE produced by own central heating;
W_{Tu} [Gcal] – Useful TE;
P_{WT} [Gcal] – TE losses ;
W_{Tacm} [Gcal] – Useful TE for domestic hot water ;
W_{Tinc} [Gcal] –Useful TE for heating;

Considering the Sankey diagram, we can observe that the TE loss is very high, i.e. 29% of the total consumption of TE.

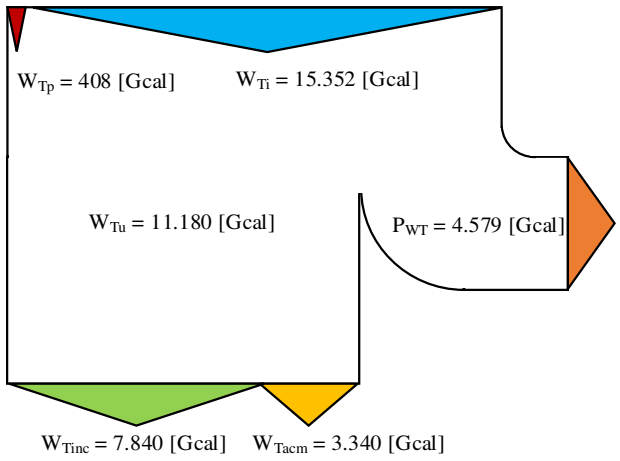

Fig. 9. Diagram of TE balance sheet for 2015, at the TF level

The recent evolution of total TE consumption provided by the supplier is represented in fig. 10, and in the load curve in fig. 11.

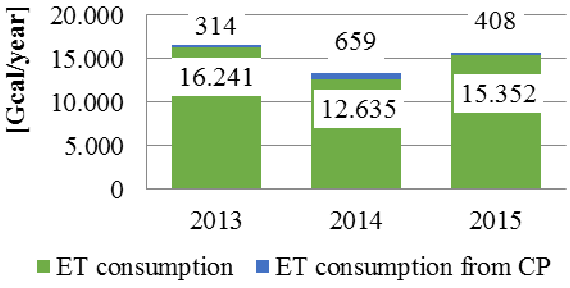

Fig. 10. Evolution of ET consumption at the TF level

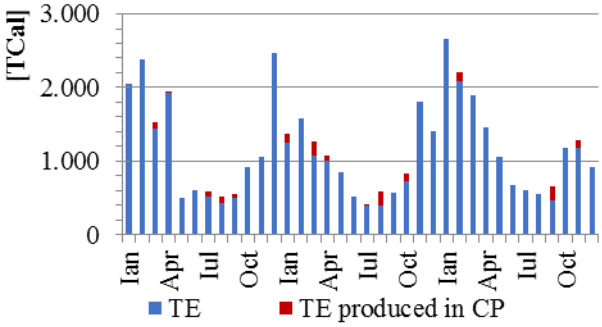

Fig. 11. Load curve of TE at the TF level

The recent evolution of TE consumption at the most important S-TF level is represented in fig. 12 ÷ 13.

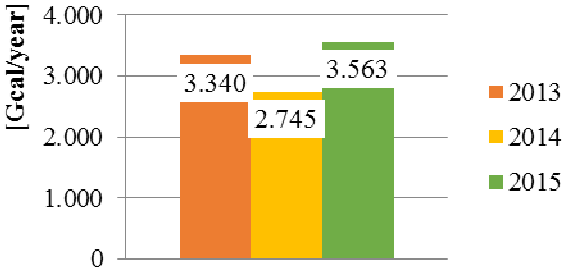

Fig. 12. Evolution of TE consumption for HI

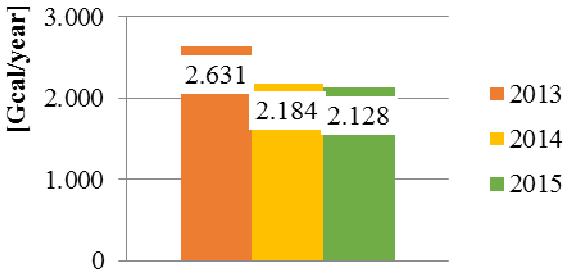

Fig. 13. Evolution of TE consumption for CT

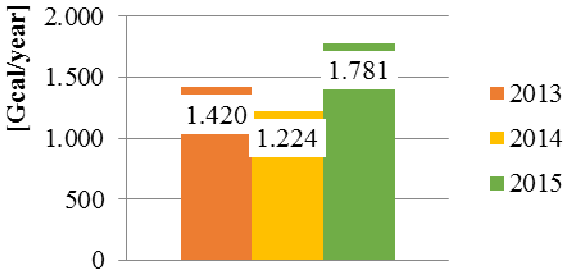

Fig. 14. Evolution of TE consumption for HP

TF is using TE for heating and domestic hot water (DHW), and the evolution of the two components is represented in fig. 15.

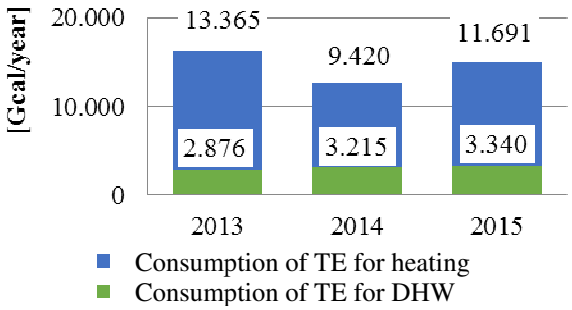

Fig. 15 Evolution of TE consumption divided to components

c) Liquid fuels (LF)

TF uses recycled fuel oil (RFO) for own heating system, petrol and diesel for vehicles. The recent evolution of LF consumption is represented in fig. 16. The average structure of LF consumption in the past 3 years is given in fig. 17.

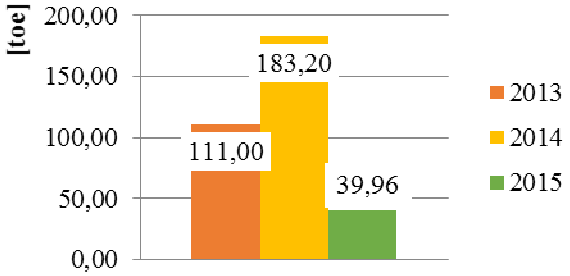

Fig. 16. Evolution of LF consumption

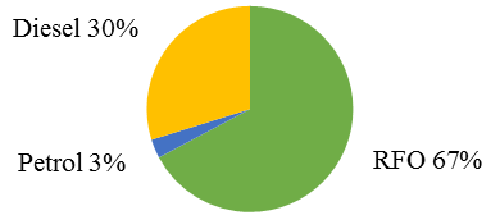

Fig. 17. Average structure of LF energy consumption in the past 3 years

2.2 Energy performance indicators

a) The comparative evolution of the value of the service performed (V_S) and the value of energy consumption (V_E) are shown in fig. 18.

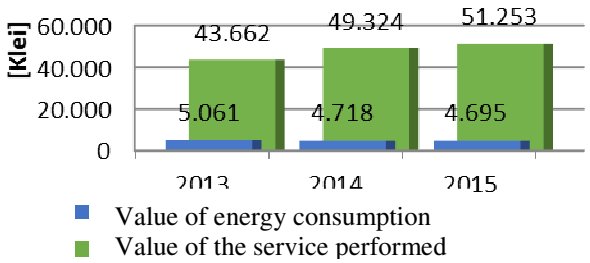

Fig. 18. Comparative evolution of V_S and V_E

It appears that, at the level of TF, the share of the V_E in the V_S is decreasing: 11,59% - 2013, 9,56% - 2014, 9,16% - 2015. For the most important units the share of V_E in V_S is represented in table.1. The share of total energy value has decreased in the last 3 years, which can be explained by lower energy prices and increased turnover.

Table 1. Weight of V_E in V_S for S-TF

Unit	2013	2014	2015
HI	10,18	6,85	7,06
CT	13,17	7,82	7,76
CA	3,74	3,89	3,57

b) Similarly, to the general pattern [16], we calculate the energy intensity (I_W) within TF and related entities, reporting total energy consumption at the value of the services performed (in fact, turnover). The evolution of I_W within TF in the past 3 years is shown in fig. 19.

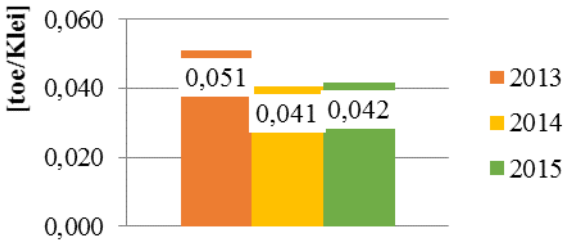

Fig. 19. Evolution of energy intensity in the TF

For the entities within TF, the values of I_W, during the analysis, are shown in table 2.

Table 2. Evolution of energy intensity at S-TF

Unit	Value of I_W [toe/Klei]			
	2013	2014	2015	Media
HI	0,045	0,032	0,035	0,037
CT	0,059	0,033	0,032	0,041
HP	0,032	0,024	0,033	0,030
HM	0,019	0,023	0,027	0,023
CA	0,009	0,010	0,009	0,009
SV1M	0,003	0,004	0,003	0,003
GG	0,022	0,018	0,022	0,020

Fig. 20 presents a comparison between energy intensity in the hotel sector from different EU countries. The average value of I_W for TF (fig.20) is converted into euro at the rate of 3,6234 lei/€ (2005).

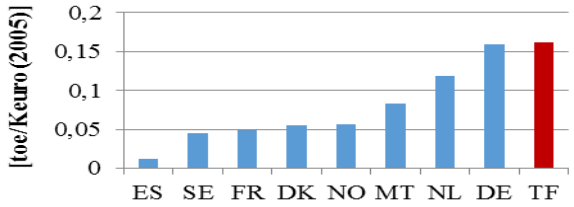

Fig. 20. I_W from hotel sector in different EU countries

c) **Specific energy consumption (C_{SW})** for S-TF are represented in table 3.

Table 3. Specific energy consumption (C_{SW}) for S-TF

Subunit	Developed area	AVG. C_S de EE	AVG. C_S de ET	AVG. C_{SW}*
U.M.	[mp]	[kWh/mp]		
HI	15.843	95	344	439
CT	14.976	58	265	322
HP	8.127	47	317	363
HM	16.356	26	156	183
TOTAL HOTELS	**55.302**	**57**	**256**	**313**
CA	26.554	27	18	45
TOTAL SPAS	**62.054**	**27**	**18**	**45**
GG	8.756	32	70	102
SA	2.992	29	567	596
TOTAL SERVICE AREA	**11.748**	**31**	**197**	**228**
PT/F	1.250	1.091	0	1.091
TOTAL GENERAL	**94.854**	**59**	**256**	**315**

*The average C_{SW} was realized for the period [2013 ÷ 2015]

2.3 Benchmarking

Considering the values of C_{SW} it is possible to make comparisons with other hotels using benchmarks from standards and directives concerning the ENEF of similar services. The comparison between S-TF is represented in fig 21 ÷ 23 (average for the period 2013 ÷ 2015).

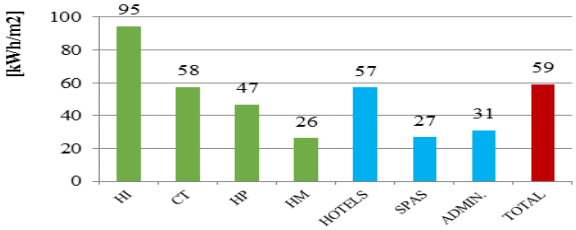

Fig. 21. C_S of EE for entities of TF

Examining fig. 21, we can see that the highest specific EE consumption belongs to HI and CT. It should be noted that HI has its own laundry and other hotel's linen is washed at GG. The laundry is an important consumer of EE. In addition, HP and HM doesn't have air conditioning system. This explains why EE consumption falls significantly in these subunits.

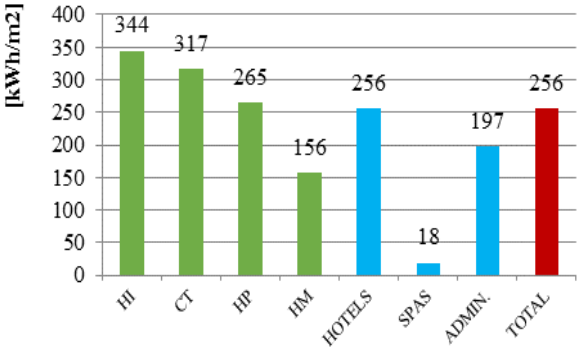

Fig. 22. C_S of TE for entities of TF

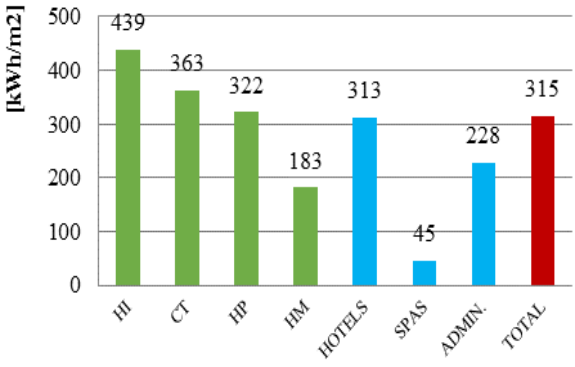

Fig. 23. Comparative representation of C_{SW} for S-TF

The benchmarks of C_{SW} are given in table 4. These values were determined in Hotel Energy Solution (HES), on the basis of data taken form about 20 studies and 80 reports providing information on energy efficiency in the hotel sector [18].

Table 4. Benchmarks on C_{SW} in hotels [18]

Qualifying	Specific energy consumption (C_{SW}) [kWh/mp/an]
Excellent (A)	< 195
Good (B)	195 ÷ 280
Average (C)	280 ÷ 355
Poor (D)	355 ÷ 450
Very poor (E)	450 <

Fig. 24 presents the comparative situation between European hotels and hotels of TF considering specific EE consumption. It is worth mentioning that in the Nordic countries in Europe (Norway, Sweden, Denmark), the main source of energy for heating is the EE, therefore in these cases the specific consumption of EE is reasonably higher than in the other European countries, most countries situated between [40 to 80 kWh/m2]. Compared with Spain or Germany, TF is similar in specific consumption of electricity [12].

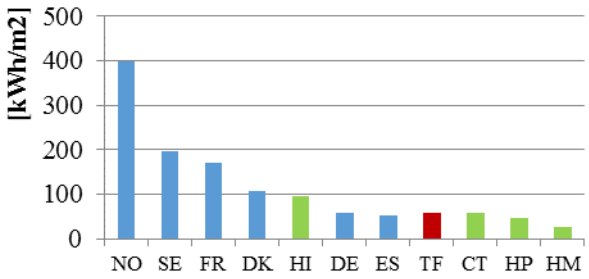

Fig. 24. C_S of EE in different EU countries [17]

3. CONCLUSIONS

- The energy consumption of TF is significant, respectively 1.836 toe in 2014, 2.104 toe in 2015, showing a 268 toe increase from 2014.
- The main form of energy consumed at the TF level is thermal energy (1.535 toe – 2015). Other forms of consumed energy are: electricity (528,6 tep – 2015) and energy of liquid fuels (RFO, petrol, diesel) in more lower quantities (39,96 tep – total, 2015).
- The cost of EE + ET in 2015 was 4.484,95 Klei, including a 47,97% proportion of the cost of EE and 52,03% of the cost of ET. In the period [2013 ÷ 2015] EE's price fell from 0,47 lei/kWh to 0,35 lei/kWh (with some small alternations). Over the same period, the cost of ET provided by SC Termoficare Oradea SA has increased from 151,99 lei/Gcal to 152,36 lei/Gcal. The invoice for energy consumption (VE) in the [2013 ÷ 2015] period fell from 5.061 Klei to 4.695 Klei, although the energy consumption grew by 22,5 toe. This cost reduction is due mainly to the price reduction of EE (0.12 lei/kWh – in this range).
- The intensity of energy between [2013 ÷ 2015] fell from 0,051 toe/ 1000 lei to 0,042 toe/ 1000 lei, which is mainly due to the increased value of services from 43.662 Klei to 51.253 Klei, but also to the decoupling of the energy consumption from the value of the service, energy consumption having increased only by 22,5 toe.
- Although the share of the value of energy consumption of the value of all the services is only ca. 10% (the average, in the last 3 years), which was even 9,16% in 2015, considering the real possibilities of reducing the energy consumption it is important to implement feasible measures that directly lead to an increase in the company's profits.
- Referring to the C_{SW}, it can be concluded that compared to the reference values for hotels (table 4), the average of C_{SW} (295 kWh/m2) and the average consumption of electricity (70 kWh/m2) in the EU for non-residential buildings [19], within the TF situation can be characterized as follows:

➢ Hotel International with 439 kWh/m2 falls in grade D, and the specific EE consumption is 92 kWh/m2 above the European average;
➢ Hotel Poienita 363 kWh/m2 grade D;
➢ Complex Termal 322 kWh/m2 grade C;
➢ Hotel Mures 183 kWh/m2 grade A, this stems from the fact that this hotel was used low rate and thus the calculated value does not reflect the real energy performance.
➢ Overall, for hotels, the specific energy consumption is 313 kWh/m2, which, as a whole, corresponds to grade C and the specific EE consumption is 57 kWh/m2 below the European average.
➢ All administrative buildings (administrative headquarters) with 228 kWh/m2 (total energy) and with specific EE consumption with 31 kWh/m2 are situated above the European average.
➢ Total with 315 kWh/m2 TF is above the European average and the specific EE consumption 59 kWh/m2 below the average. This situation can be explained not only by the performance of installations, but also by the relatively low degree of utilization in some of those locations.
➢ Of all the hotels of TF, Hotel International has the lowest energy performance, followed by Hotel Poienița, Complex Termal and Hotel Mureș.

- The results achieved reflect the usefulness of initiating actions in improving energy efficiency within TC.

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