A Study on Energy and Cost Efficiency for Existing Hotel Buildings in Turkey

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Abstract. In Turkey, according to TUİK Sectoral Energy Consumption Statistics (2006), the hotel buildings with the highest share, constitute 35% of the total building energy consumption. Energy needs and consumption behaviours differ according to the typology of the building. Energy Performance of Buildings Directive (EPBD) has been adapted to the conditions of Turkey to increase energy and cost efficiency, to reduce the environmental and economic negative effects. The energy consumption and the global cost were investigated under different conditions in an existing hotel building. The paper is unique in its ability to deliver optimum solution through comparison by evaluating energy and cost efficiency at the same time considering sectoral, climatic, technological and economic national conditions when the literature research detailed in the present works about the problem is evaluated in detail. All findings have been compared simultaneously under different climate regions of seasonal and yearly working conditions of selected test hotel to obtain the energy and cost efficiency. Among the proposed improvement scenarios, the optimum scenario is determined in terms of cost and energy efficiency in S18 which has the highest energy efficiency. In this case, both insulation material type and thickness as well as glass type can be bent and through multiple measures can be achieved by 25.7% improvement for energy efficiency.

1 Introduction

Due to migration and rapid population growth, the energy demand in our developing country is increasing rapidly. Turkey's Gross National Product per consumed representing the amount of primary energy and the energy density is an indicator used in all around the world is more than twice the European Union.

The per capita energy consumption in Turkey, which was 1493 kWh in 2000, increased by approximately 80% to 2,682 kWh in 2014 [1]. When primary energy consumption is taken into consideration as of 2016, Turkey take place on the rank 19th among all the countries in the world with 129.3 MTEP. Turkey's electricity consumption was go up 65.7 billion kWh increasing doubled in 2015, which was 132.6 billion kWh in 2002. According to Ministry of Energy in Turkey, about one third of the energy produced is consumed by buildings in 2005 [2].

On the other hand, there is the potential to minimize the amount of energy consumption in buildings by ensuring the efficient use of the energy produced maintaining the comfort conditions. According to the sectoral reports by the Ministry of Energy, the saving potential rate is 30% in buildings, 20% in industry and 15% in transportation [3]. When the energy consumption data is analyzed by sector, it is seen that the energy consumed by the buildings is the highest in the service sector after the housing and office buildings. In the service sector, the largest energy consumption rate is 35% for the hotel/ accommodation [4]. Since the cost of energy consumed is at the top of the expense items, many researchers and hotel managers concentrated their attention on the amount of energy consumption. The average daily electricity, water and fossil fuel consumption per person in 5-star hotels is given in Table 1.

Table 1. The average daily energy consumption in hotels

Electricity	Water	Liquid Natural Gas
21-22 kW	420-440 L	7-10 L

Given World Tourism Organization, 2017 data in terms of tourism revenue and tourist numbers one of the top ten countries is Turkey. There are so many tourism types such as summer/sea tourism, winter/mountain sports tourism, plateau tourism, commercial/convention hosting the city tourism because of seasonal, historical and cultural reasons.

The energy efficiency of the large hotel buildings such as 5-star hotels and resorts should be considered differently from the other building types such as residential and commercial buildings because of the fact that they contain variable building geometry, many different functional spaces, and different working time schedules.

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According to Distribution of Foreign Tourists Visited Turkey as of Years and Months, 2017 during the six months of summer tourism, including May and October, it welcomes foreign tourists about three times more than the other six months [5].

It is an indisputable fact that the way to reduce energy consumption and energy costs in buildings is possible by increasing energy and cost efficiency.

1.1 Building Efficiency Parameters

1.1.1 Building Energy Parameters

Building energy performance is the amount of energy consumed to meet the standard requirements of heating, cooling, ventilation, lighting and hot water in accordance with the comfort conditions depending on the function of the evaluated building [6].

Building efficiency parameters can be summarized as climate data, location, orientation, form, obstacle status, building shell, usage charts, domestic earnings, natural ventilation, active heating systems, active cooling systems, active ventilation systems, lighting systems, hot water systems, renewable energy systems.

1.1.2 Cost Efficiency Parameters

The effects of global cost effectiveness are on building and material life, initial investment, renovation costs, heating, cooling, lighting, hot water, fans and pumps, and other energy consumption. quantities, energy unit prices, subscription and access fees, building life cycle, inflation rate, market interest rate, real interest rate, the value at the end of the calculation, discount rate, maintenance and repair costs [7].

Global cost variables are the initial investment cost, renovation cost, operating cost, life cost.

1.1.3 Comfort Parameters

Comfort parameters evaluated in building as thermal comfort and visual comfort.

Thermal comfort means that people should be in a certain comfort while maintaining their physical and mental activities in terms of climate conditions such as temperature, humidity and air flow. Indoor temperature is the most important parameter for thermal comfort. The indoor temperature should be at a level where people feel comfortable according to the function of space for winter and summer situations. The ideal indoor temperature varies depending on the type of work being done and clothing factor. The amount of moisture in the indoor environment is another factor that determines thermal comfort. In most sources, it is recommended to have a relative humidity of 30-80%. A suitable air flow rate must be provided to ensure thermal comfort and to remove gas and dust that are harmful for human health. It should be ensured that the air flow rate does not exceed 0.3 to 0.5 meters per second.

Visual comfort, physiological and psychological comfort are combined. Physiological comfort is related to the measurable values of the lighting (quantity), psychological comfort, the undetectable values of the lighting (quality). Some of the important parameters discussed for visual comfort assessment are lighting level, glare, maintenance factor.

1.2 Nearly Zero Energy Building

Energy requirement is very low, with very high energy performance and the required amount of energy is mostly defined as the building from which renewable energy sources are met.

For the term lem very high energy performance as defined in this definition, there is no regulatory standard value and each EU member country is expected to determine this level in accordance with its national requirements through calculations.

Approximately zero energy building concept, cost in the same directive is directly related to the concept of optimum energy efficiency.

Cost optimum energy efficiency level is defined as energy performance level which results in the lowest cost during the economic life period according to Energy Performance of Buildings Directive (EPBD) Recast and this level is until the end of 2020, it is aimed to catch the zero energy level [8].

1.3 Net Zero Energy Building

Net Zero Energy Building is defined as a building that has a very low energy demand, has a very high energy performance, and is able to supply all or more of the required amount of energy from renewable energy sources and sell some of the renewable energy produced [9].

2 Methods

Many of the National Calculation Methods are concerned with the calculation of the initial energy consumption of buildings, but the determination of the calculation stages and the relevant energy needs varies from country to country. Exterior temperature and indoor comfort conditions vary from country to country. Therefore, although the performance evaluation criteria are the same, building performance calculation models differ from country to country due to differences in climate conditions and comfort conditions.

EN 13790, an umbrella document, proposes three different precision methods for the calculation of Building Energy Performance. The detailed dynamic method of these methods is an overly detailed and impractical method for the building energy certification method which takes into account the interaction of the umbrella document between the simultaneous, multi-zone zones in buildings, directed by the EN 15265 Standard for the Calculation of the Energy Needed in Ambient Heating and Cooling Using Dynamic Methods for Buildings [10]. It is necessary to evaluate the energy

performance and greenhouse gas emissions of complex buildings with a large number of thermal zones having different requirements.

In 2010, the renewed directive (EPBD Recast) envisages a combination of the energy and cost effectiveness of buildings and calculates the building energy consumption in terms of primary energy using detailed dynamic methods.

In the calculation of energy consumption, detailed dynamic calculation method is developed and widely used by the US Department of Energy (DOE) EnergyPlus V8.1. software is used. The building and building environment is defined by the three-dimensional modeling program SketchUp and OpenStudio.

Detailed dynamic simulations, heating, cooling, lighting, equipment and other energy consumption, total energy consumption, comfort conditions and mechanical system component sizes are obtained for different time intervals, such as hourly, daily, monthly yearly and so on.

2.1 Local Inputs

One of the most critical points of building energy performance simulations is that the input data of building energy performance parameters is correctly defined. Climate data is of great importance among these parameters. Climate data can be obtained from climate data contained in EPlus. Turkey's prepared for all cities outside temperature, wind and humidity values for long-term averages Excel interface with EPlus meteorological data was revised and the case can be brought close to the truth.

In Turkey, taking into account the social and cultural structure of the hotel industry study timelines, comfort conditions of the input data must be defined correctly.

Turkey's economic conditions for cost analysis have been performed of the global cost of using national data.

For local building materials, the thermophysical and technical properties of the material must be correctly defined.

2.2 Steps forming the approach

The basic steps for the approach are given in Table 2 [11].

Table 2. The steps of the approach.

S1	Identification of existing hotel building parameters
S2	Energy analysis for existing hotel building
S3	Global cost analysis for existing hotel building
S4	Evaluation of the current situation
S5	Determination of improvement scenarios for passive and active energy systems
S6	Energy analysis for improvement scenarios
S7	Performing global cost analysis for improvement scenarios
S8	Selection of cost-optimal energy improvement scenario

2.3 Calculation of primary energy consumption for existing hotel building

The consumption calculated to compare the energy consumption of the scenarios where the existing building and improvement packages are applied on an equal basis should be converted to primary energy type [12].

In Turkey, for electrical primary energy conversion coefficient is 2.36 for natural gas and other fuels are 1.

$$BE(e) = T_{EET} * 2,36 \qquad (1)$$

$$BE(d) = T_{DET} * 1 \qquad (2)$$

$$TBE = BE(e) + BE(d) \qquad (3)$$

BE (e): Total primary electrical energy consumption
BE (d): Total primary consumption of other energy sources
T_{EET}: Total electrical energy consumption
T_{DET} : Total consumption of other energy sources
TBE: Total of primary energy consumption

2.4 Calculation of carbon emission for existing hotel building

The variable carbon emission coefficients are multiplied by the relevant fuel consumption and the annual carbon emission of the whole building is obtained by equality (4).

In our country, carbon emission conversion factors are 0.234 for natural gas, 0.626 for electricity and 0.33 for liquid fuel [13].

$$E_{CO2} = (e_{dg} * 0.234) + (e_e * 0.626) + (e_{sy} * 0.33) \qquad (4)$$

E_{CO2}: Total Building Carbon Emission
e_{dg}: Energy consumption from natural gas
e_e: Electricity consumption
e_{sy}: Energy consumption by liquid fuel

2.5 Calculation of initial investment costs

The initial investment cost can be divided into three main categories: direct cost (materials, transport and labor), indirect costs (infrastructure, contracting assistance, overhead) and taxes.

To determine the direct cost of materials, it is more reliable to average the costs collected from three different construction material suppliers 25% of the direct cost in Turkey are assumed to be equal to the indirect costs [14].

$$CI_n(S_n) = CIn(p) * (1 + R_d(i) / 100)^T \qquad (5)$$

$CI_n(S_n)$: Initial investment cost (for each step)
$CIn(p)$: Today's initial investment cost
R_d: Discount rate for implementation year
T: Application year

2.6 Calculation of global cost analysis for existing hotel building

The global cost calculation method takes into account the increasing value for the equipment that has a life span of more than the building life, falling from the total cost.

For global cost analysis, the global cost calculator is prepared with the equation (6) through Microsoft Excel software. The inflation rate used in the calculations was 8.1% for 2015 and 14.3% for the market interest rate [15].

$$Cg(\tau) = CIn + \sum_{j}\left[\sum_{i=1}^{\tau}\left(Cy(\tau) + Cr(\tau)\right) - Vf, \tau(j)\right] \quad (6)$$

Cg (τ): Global cost
CIn: First investment cost
Cy (τ): Operating costs (maintenance, operation and energy costs)
Cr (τ): Renewal cost
Vf, τ (j): The last value of component j corresponding to T year

3 An existing hotel building in Turkey

Turkey in accordance with the conditions, in order to determine the improvements to be made in the existing hotel building scenario is compared to the findings obtained from energy and cost analysis of an existing hotel building.

3.1 Identification of the sample existing building

The present example building is a four-story, four-star seasonal tourism facility consisting of a basement, a ground floor and two bedrooms. The hotel has 84 rooms, including 6 corner suites and 78 standard rooms. Functional facilities in the hotel, 24-hour café-bar, multi-purpose hall for 200 people, foyer, à la carte restaurant for 80 people, kitchen, warehouses, cold storage, public toilets, hairdresser, infirmary, offices, Turkish bath, sauna, massage, gym, lobby and laundry facilities.

This hotel is located in the touristic town in the Aegean region, Bodrum. The building is designed in U form as shown in the Figure1 so that all rooms can benefit from the view. Balconies are organized gradually so as not to interfere with each other. At the same time, it serves as a sunshade fringe for windows.
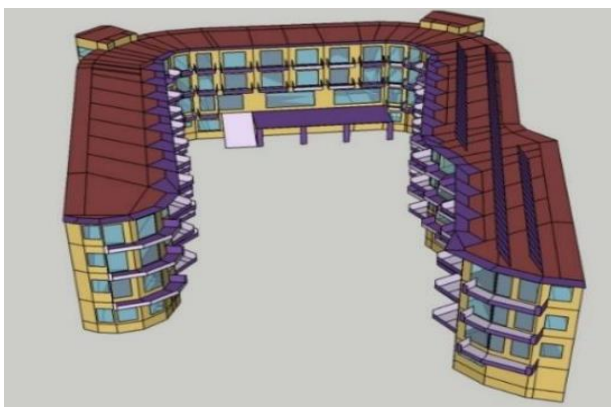
Fig. 1. 3D image of the existing hotel building which has been modeled by OpenStudio.

The technical properties of the building opaque and transparent element of the hotel are listed in the Table 3 below. For window glass of hotel Solar Heat Gain Coefficient (SHGC) is 0,737 and Visible Transmittance (VT) is 0,797.

Table 3. Technical properties of the building elements.

Building elements	U Value
Exterior wall	0,38
Indoor floor	1,828
Outdoor floor	0,423
Roof	0,308
Window glass	2,7
Window frame	1,3

The orientation of the building to the north is shown in Figure 2.

Fig. 2. An image of existing hotel building from the top.

The building's HVAC system was tested using the EPlus v.8.1 dynamic simulation tool. General heating and cooling of the building is carried out using the VRF system. The indoor units in the conditioned areas are connected to the selected VRF outdoor units and these indoor units circulate the indoor air of the environment and condition the environment. The hotel set temperature is 21-26 ° C in the bedrooms, wet rooms, stair halls and corridors are open to the outside is not conditioned. In addition, the sanitary hot water system of the building is provided by an electric boiler with a capacity of 30 * 4 kW, and 80 solar collectors in the south are supported by the sanitary hot water system. Each of the solar collectors has an active area of 2.1m² yield of 83%.

The ventilation strategy of the test building is defined by adhering to the ventilation type of the existing building and is provided in a natural way. The bathrooms in the rooms do not have heating cooling, but only the dirty air is exhausted by the exhaust fan.

The existing building is designed using energy-saving led luminaires, and in the public areas such as corridor and wc, the lighting is motion sensor. The lighting system of the test building is screened according to the function of the spaces and is defined in W per unit area as shown in Table 4 as internal gains.

For the cost of electricity used in cost analysis, unit price of 2014 is obtained from the invoice and received as 0.235878 TL.

In this paper, building energy performance analyzes are carried out on two different climatic zones for the

application example. In the specified test scenarios, the same geometrical form of application is located in Bodrum and Erzurum to represent the hot-humid and cold climate.

The hotel located in Bodrum, is a hotel that serves summer tourism and works for eight months including March and October. Although the local climate is a bit different, the climate data of the central province of Muğla are used in the simulations because of the lack of relevant local climatic data. In this building, user behavior and occupancy rates are defined according to the interviews made with the hotel management.

For cold climate, the hotel building with the same geometrical features and functional spaces assumed to be located in Erzurum Palandöken is suitable for the ski season in November, December, January and February operating four months a year analyzes were performed. Climate data still belongs to the city center of Erzurum.

The zone list includes the setting temperatures of the zones and the internal gain values are listed below in Table 4. Internal gainss from lighting and equipment were obtained from the large-scale reference hotel building data prepared for commercial reference buildings by the United Nations Department of Energy.

The equipment is designed for the minimum equipment in each functional room in the hotel standards. electrical appliances such as kettles, tv, mini fridges, hair dryers for bedrooms. The number of people in the bedrooms and the number of beds available in the hotel is obtained by proportioning the number of beds. The setting temperatures defined for each zone are from DIN EN 18599 benefited from [16].

Table 4. Zone list.

Zone list	Set Temperature	Internal Gains		
		Lighting W/m²	People W/man	Equipment W/m²
Rooms	21°C-26°C	11,84	11	14,3
Corridors	16°C-30°C	11,84	11	14,3
Staircase	16°C-30°C	11,84	11	14,3
Lobby	21°C-26°C	11,84	11	14,3
Massage	21°C-26°C	11,84	7,51	14,3
Fitness	18°C	12	13,5	9,01
Sauna	50°C	11,84	12,5	14,3
Toilets	-	11,84	-	-
Turkish bath	50°C	12	2	10
Storage	-	9	-	-
Infirmary	21°C-26°C	11,84	7,64	-
Hairdresser	21°C-26°C	15	8,49	40
Offices	21°C-26°C	13,2	7,59	15,1
Cold storage	-5°C-+5°C	9	-	-10
Main kitchen	21°C-26°C	12	13,5	150
Restaurant	21°C-26°C	12	2,27	10
Lounge	21°C-26°C	11,84	11	14,3
Foyer	21°C-26°C	11,84	11	14,3
Multipurpose hall	21°C-26°C	11,84	11	14,3
Cafeteria	21°C-26°C	11,84	32,01	14,3

The base building is the situation where there are no balconies to shade the building and no heat insulation.

The thickness and the type of heat insulation, glass type, shading element and changing positions are selected as basic analysis parameters. In this paper, the results of 22 simulations including the proposed 20 improvement scenarios, the base building and the existing building were included shown in Table 5. Some abbreviations are used in the tables such as "RW" is rockwool, "B" is Bodrum, "E" is Erzurum, "Ref" is reflectivity, "Trans" is transmittance, "Med" is middle, "Sol" is solar.

Table 5. Scenarios list.

Scenarios	Heat Insulation	Window Type	Semi-Transparent Vertical Shading
Base Building	Non	4+16air+4 Clear Glass	Non
Existing Building	5 cm RW	4+16air+4 Clear Glass	Non
S1 B/E	5 cm eps	4+16air+4 Clear Glass	Non
S2 B/E	8 cm eps	4+16air+4 Clear Glass	Non
S3 B/E	4 cm eps	4+16air+4 Clear Glass	Non
S4 B/E	5cm RW	4+16air+4 Comfort Type	Non
S5 B/E	5 cm RW	4+16argon+4 Comfort Type	Non
S6 B/E	5 cm RW	6TS+16air+6 Low-e	Non
S7 B/E	5 cm RW	4+12air+4+12air+4 Sinergy Type	Non
S8 B/E	5 cm RW	4+12air+4+12air+4 Comfort Type	Non
S9 B/E	5 cm RW	4+16air+4 Clear Glass	MedSolRef MedSolTrans
S10 B/E	5 cm RW	4+16air+4 Clear Glass	HighSolRef LowSolTrans
S11 B	5 cm RW	4+16air+4 Clear Glass	LowSolRef. HighSolTrans
S12 B	5 cm RW	4+16air+4 Clear Glass	LowSolRef LowSolTrans
S13 B	5 cm RW	4+16air+4 Clear Glass	LowSolRef MedSolTrans
S14 B	5 cm RW	4+16air+4 Clear Glass	MedSolRef LowSolTrans
S15 E	8 cm eps	4+16air+4 Comfort Type	Non
S16 E	8 cm eps	4+16argon+4 Comfort Type	Non
S17 E	8 cm eps	6TS+16air+6 Low-e	Non
S18 E	8 cm eps	4+12air+4+12air+4 Sinergy Type	Non
S19 E	8 cm eps	4+12air+4+12air+4 Comfort Type	Non
S20 E	10cm eps	4+16air+4 Clear Glass	Non

3.2 Findings of the energy and cost analysis for Bodrum

Considering the annual energy consumption of all the scenarios proposed for Bodrum, it is seen that heating energy consumption is quite low due to the seasonal work of the sample hotel. Current situation total 171 kWh/m² while the lowest consumption amount obtained with individual improvements is S9 with 119,7kWh/m2.

The energy consumption results for all scenarios are given in Table 6. The results of global cost analysis for chosen scenarios are given in Table 7.

Table 6. The energy consumption results for Bodrum.

Scenarios	Heating kWh/m².a	Cooling kWh/m².a	Equipments and others kWh/m².a	Annual Energy Consumtion kWh/m².a
Base Building	5,5	72,6	98,6	193,7
Existing Building	5,4	63,0	85,4	171,0
S1 B	5,4	63,2	85,7	171,4
S2 B	5,3	63,9	86,2	172,4
S3 B	5,4	62,9	85,5	170,9
S4 B	5,6	49,7	75,4	147,8
S5 B	5,6	50,7	76,2	149,6
S6 B	6,1	39,4	67,8	130,4
S7 B	5,5	54,2	78,8	155,6
S8 B	5,6	49,9	75,6	148,1
S9 B	6,7	32,9	63,1	119,7
S10 B	6,5	34,4	65,3	123,3
S11 B	6,5	35,6	65,1	124,2
S12 B	5,9	45,5	72,4	140,9
S13 B	5,8	46,6	73,2	142,8
S14 B	5,5	57,2	81,2	161,0

Table 7. The global cost findings for Bodrum.

Scenarios	Global Cost TL
S7	3.175.789
S11	3.168.519
S8	3.049.978
S5	3.020.706
S4	2.977.500
S13	2.809.465
S9	2.773.709
S6	2.737.991
S12	2.453.644
S14	2.435.638
S10	2.366.867

3.3 Findings of the energy and cost analysis for Erzurum

According to the findings of the scenarios for winter season active Erzurum sample, this time, the test building is located in the cold climate and it is seen in the results of the analysis that the heating consumption is at quite high levels compared to the other climate zone despite the high internal gains it has due to the function of the building. Among the scenarios determined, S18 has the highest energy efficiency shown in Table 8. In this case, both insulation material and thickness as well as glass type can be bent and multiple measures can be achieved by 25.7% improvement.

The global costs were assessed for the Erzurum sample, which was assumed to operate only during the ski season, and the lowest cost was obtained with S7. S18, where energy consumption is the lowest while the highest cost was observed in S7 shown in Table 9.

The emergence of situations in which energy efficiency and cost-effectiveness differed considerably indicated that the analyzes should be evaluated together.

Table 8. The energy consumption results for Erzurum.

Scenarios	Heating kWh/m².a	Cooling kWh/m².a	Equipments and others kWh/m².a	Annual Energy Consumtion kWh/m².a
Base Building	55,4	0,6	58,8	117,2
Existing Building	47,7	0,9	53	104
S2 E	45,1	1,1	51,1	99,6
S20 E	44,4	1,2	50,6	98,4
S4 E	46,3	0,8	51,7	101,2
S15 E	42,7	1	49,2	95,3
S5 E	44,4	0,9	50,4	98
S16 E	40,7	1,1	47,7	92
S7 E	41,3	1	48,1	92,8
S18 E	37,7	1,4	45,6	87,1
S8 E	43,4	0,9	49,6	96,3
S19 E	39,8	1,2	47	90,3
S10 E	62,4	0,6	64,2	129,6
S9 E	56,6	0,6	59,7	119,3
S17 E	49,3	0,8	51,8	104,2

Table 9. The global cost findings for Erzurum.

Scenarios	Global Cost TL
Base Building	**2.251.956**
Existing Building	**1.998.514**
S7	1.759.969
S8	2.054.667
S5	2.030.452
S4	2.080.774
S9	2.258.309
S10	2.556.568
S19	2.240.325
S20	2.270.105
S2	2.179.868
S15	2.177.435
S16	2.120.209
S18	2.051.142

3.4 Determination of energy and cost optimum improvement scenario

The selection of the optimum improvement scenario is done by graphing the primary energy in the X axis and the global cost values on the Y axis from the findings obtained from the analysis. With the help of this graph, the scenarios of the current situation and test are seen comparatively. Among the scenarios, the option, which has the lowest energy consumption at the optimum cost, is taken as the basis for the application.

However, choosing between scenarios where energy efficiency and global costs are very close to each other will be possible by other reasons such as the aesthetic or process that the investor / designer will consider.

Based on all findings, the measures to be taken in order to increase the energy and cost effectiveness of the hotels that are located in different climate regions and serve in different tourism seasons vary.

In the case of Erzurum, S18 was chosen as the cost-optimized improvement scenario among the tested scenarios because the primary energy consumption was the lowest scenario shown in Figure 3.
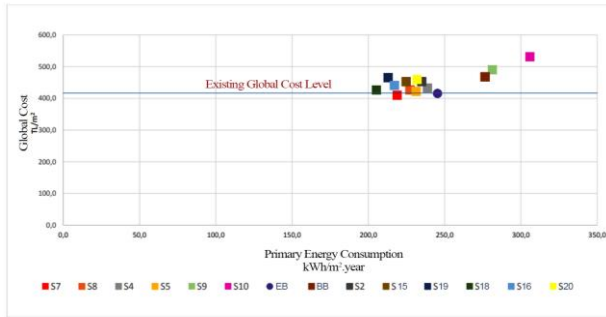

Fig. 3. Energy-Cost optimal graphic for Erzurum.

4 Conclusion

In this paper, it has been developed to increase the energy and cost efficiency of the existing hotel stock as a general framework, and by following this method, it allows to test different alternatives and to determine the optimum alternative among them. In different climatic zones, in different building forms, different thermal zones are identified, and possible improvement packages have been identified with the method developed for hotels with different capacity and usage and with a fluid structure that can reach the purpose for the functional spaces.

Based on the proposed approach, the results of the analysis of the characteristics of the hot humid climate region and the high internal gain values in the complex buildings of the hotel are mainly highlighted by the analyzes of the cooling loads. The energy efficiency of the improvement scenarios based on the reduction of solar gains for this climate zone is high.

According to the energy analysis of the same current building, which only serves the winter period, in the cold climate zone (Erzurum), despite the high internal gains caused by the function and capacity of the building, it is seen that the purpose of the weighted consumption in the building is heating. In this case, both insulation material type and thickness as well as glass type can be bent and through multiple measures can be achieved by 25.7% improvement for energy efficiency.

This time, instead of solar control, it has been found that the role of window type and heat exhaustion improvement scenarios, which minimize heat losses, increased in cost optimal energy efficiency.

Through the results and comparisons obtained from the paper, the applicability of the approach is tested. When we look at the findings obtained from the energy and cost analysis of existing building and improvement scenarios, it is observed that the role of energy efficiency

parameters and the rate of efficiency of the same parameters vary according to the difference of the annual working schedules of hotel buildings located in different climate regions.

EPBD Recast (2012) developed the method of calculation for the EU member and candidate countries in accordance with their national conditions and determined the optimum cost levels of energy performance requirements in the buildings with this method the building energy performance is required to be integrated into the calculation methods and approximately zero energy building [17].

For the improvement of hotel buildings with a high potential for energy conservation, specific remediation measures according to the study timetable specific to the climate region should be determined at the national level.

In order to evaluate the energy efficiency of hotels, it is urgent to determine the reference hotel building which is not yet defined in our country.

Legislative arrangements should be made for the replication of the improvement measures to include active systems and the implementation of the improvements based on the relevant invoice values.

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