Primary Energy of the District city and Suburb

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Abstract. In member states of the European Union, portion of buildings in the total consumption of energy represents 40 %, and their share in CO₂ emissions represents 35 %. Taking into account the dependence of the European Union on import of energy, this represents a large quantity of energy and CO₂ in spite of the fact that effective solutions for the reduction of energy demand of buildings exist. The European Union adopted three main commitments for fulfilment of criteria by year 2020 in the 20-20-20 Directive. Based on this Directive Slovakia declares support for renovating the building stock. The goal of the paper was to prove that renovation of the building stock is environmentally and energy preferably as construction of new buildings. In the paper, the settlement unit with the suburban one were compared. Both territories are dealt with in Kosice city, in Slovakia. The settlement units include apartment dwelling houses, amenities, parking areas and green. Suburban part contains family houses. The decisive factor for the final assessment of the buildings was global indicator. Global indicator of the energy performance is primary energy. The new building must meet minimum requirements for energy performance and it must be classified to energy class A1 since 2016, and to energy class A0 since 2020. The paper analyses the effects of the use of different resources of heat considering the global indicator. Primary energy was calculated and based on comparable unit. The primary energy was accounted for on the built-up area, area corresponding to district city and suburb, number of inhabitants. The study shows that the lowest values of global indicator are achieved by using wood. The highest values of global indicator are achieved by using electricity or district heating as an energy source. The difference between the highest and lowest value is 87 %. Primary energy based on inhabitant is 98 % lower in settlement unit compared to the suburban one.

1. Introduction

Man is a social creature. People like to visit, talk to each other, have fun and thus satisfy the need of association or social contact. One of the largest associations of people is represented by settlement units [1]. Such settlement units are found around the whole world. In settlement units, there are all layers of the population. Settlement units are still a natural parts of the Slovak towns image and subject matters, how do we handle our urban inheritance. In the past, architects tried to solve existential questions of the modern city and the shortage of habitation. These idealistic ideas were distorted by authoritarian regime, the rate was exceeded that would be both feasible and viable for cities and their inhabitants. The contradiction between what was planned and what was actually built, increased over time. Resistance to this culminated in the society, especially abroad, where they began to deal it earlier and propose solutions for their renovation. Criticism is appropriate. On the other hand, the settlement units are real and we cannot just ignore them. In apartment dwelling houses (ADH) lives about half of the population of Slovakia [2, 3]. Demolition of the ADH was a real process in the past that was taking place across
Europe. It happened in places, where the houses were privately owned by their residents or were uninhabited. In eastern Berlin and Glasgow, it was possible to break down the entire settlement unit, because people moved away from there. In Finland, Denmark, Holland and Vienna people were moved away and when the settlement units were completely renovated they moved back. This situation did not happen in Slovakia. ADH are privately owned by residents [4]. What does it mean for the settlement units in Slovakia? Will they ever be renovated? What is reason? Is really a problem that the ADH are owned by residents?

According to Okamura, mankind should to investigate, solve and deal with how to better use things which already exist without another expansion. First, mankind always has to look at the reserve. We should search the real economic, social and environmental improvements through the rational planning. Osama Okamura states that the sophisticated urban design lacks the most. Today’s reality is that the suburbs seem to be intended for living, while the cities are place for work and entertainment. It is a serious and adverse effect. A good city is characterized by spatial proximity. We deal with the space requirements that the cars in the city require. Traveling every day from the suburbs to the city and back, takes hours. Is the time, that mankind spends by daily traveling irrelevant? Is it a necessary and normal to spend hours and hours in vehicles? Or has traveling become the aim of life, the lifestyle [5]? The EU commission states in the document The Green Paper of the Urban Environment from 1990: The development of suburbs is seen as a threat of functioning cities and contented life [6].

Residential building stock do not reach the standard design life cycle, aging faster, in Slovakia. This objectified life cycle appears to be in panel ADH for 7 – 8 years lower than the design life cycle (80 years). Taking into account the period of construction of individual building systems and their current shabbiness, in time of 20 years will be necessary to make a solution of ADH in the end of the lifecycle. The first emergency parts of ADH in several building systems are expected around 2020. Critical are concrete façade casing with light fillers, which objectified lifecycle is estimated by the year 2035 [7].

Apartment dwelling houses are renewed in Slovakia. The renovation of ADH can be divided into three basic groups as follows: ADH without any renovation, ADH after partial renovation, ADH after comprehensive renovation. A common feature of buildings older than 30 years, which were built in Slovakia mainly in the period of 1960 to 1992 in mass forms of the construction, is high wear of building equipment, which has to be quickly replaced with elements having the quality and properties creating required safety and internal comfort of these buildings for the next longer period of time. Static and technical deficiencies of building structures are other common negative features, which are affected by the original technical design, method of construction, but mainly by insufficient maintenance and repairs. In some cases, there are the emergency conditions of ADH [8]. The total specific energy use in these buildings is in range of 140 – 180 kWh·m⁻²·a⁻¹. The targeted renovation of the housing stock older than 20 years has been taking place in the Slovakia since 1992, mainly by thermal insulation and removal of static deficiencies. The construction of panel ADH was terminated in 1993. All these ADH should be gradually renewed. This is based on knowledge that the housing stock younger than 20 years is subject to cyclic maintenance and repairs; the housing stock older than 20 years must be renewed [8].

This type of renovation is related to ADH and their building structures forming mainly the thermal exchange envelope. This is the replacement of original filling structures with new ones, mainly plastic, with better thermal-technical properties with the application of external thermal insulation contact system (ETICS). In this case, it is also necessary to regulate the heating system [9]. The total specific energy use in these buildings is in range of 45 – 70 kWh·m⁻²·a⁻¹.

Renovation is solved by subsidies for renovation and insulation of apartment dwelling houses in Slovakia. This form is not effective, respectively it does not complexly solve the problems of renovation. If the renovation of the existing building stock has to provide the full-fledged living for the future
generations and if it has to be solved by EU strategies, is necessary that the renovation needs to be seen in the wider context as such. The comprehensive renovation should relate not only to ADH, but it should solve the entire urban settlement. In the case of this type of renovation, hidden potential should be used in full extent. Enlargement of useful areas in apartments; interconnection of several apartments into one apartment, either horizontally or vertically; modernization of architectonic aspect of ADH; utilization of renewable energy resources in ADH (application of solar and photovoltaic system on the roof of ADH, or integration of this system directly into the façade; utilization of heat pump, ...); application of the unit with the recovery of heat; application of intelligent control systems and others. The total specific energy use in these buildings is in range of 20 – 30 kWh·m⁻²·a⁻¹.

Living in suburb in a family house is the most difficult forms of housing considering material and energy. Ecological is living, where on 1 ha live 100 inhabitants, then where only 30 inhabitants live. Because the demands on infrastructure developments are in both cases about the same [5].

The goal of the paper was to compare and assess the energy performance of the district city and suburb. Both territories are dealt with in the city of Kosice situated in Slovakia. The decisive factor for the final assessment was the global indicator. Global indicator of the energy performance is primary energy. Comparison of the results has been processed for different approaches of renovation (without any renovation, after partial renovation, after comprehensive renovation). Primary energy was calculated and based on a comparable unit. The primary energy was accounted for on the built-up area, floor area and number of inhabitants.

Type of the energy medium is closely related to the amount of primary energy. Primary energy is the global indicator of minimum energy performance of building. It is determined from the quantity of energy supplied into the technical system of building according to individual places of consumption in the building and energy media using the modified primary energy coefficient. The quantity of energy supplied in kWh·m⁻²·a⁻¹ is multiplied by the relevant primary energy factor for the given type of energy (for example, coefficient for electrical energy is 2.20 for lump wood it is 0.1) [10, 11]. Minimum requirement for energy performance of buildings with the global indicator value for buildings is represented by upper limit of energy class A1 after year 2015 (63 kWh·m⁻²·a⁻¹ for ADH, 108 kWh·m⁻²·a⁻¹ for family houses) and upper limit of A0 after year 2020 (32 kWh·m⁻²·a⁻¹ for ADH, 54 kWh·m⁻²·a⁻¹ for family houses) [10, 11].

2. Methods

2.1. District city

District city Kosice - Sever is the largest district in Kosice and its area is approximately 55 km². It is located in the northern part of Kosice city. It includes residential areas of each character. This part of the town has a high average age. Of the approximately 20 400 inhabitants about 4 200 (20.4%) are retirees. Population density is 369 inhab./km² [12].

Reearched territory is located between the Watsonova Street, Bozeny Nemcovej Street and Letna Street. The total area of the researched territory is 147 550 m². Approximately 1 724 residents live in the researched territory [12, 13].

In the researched territory are predominantly found poured concrete (LB) system and brick system of ADH, Figure 1. Structural system of poured concrete (LB) was carried out between 1958 and 1968. Terraced and pointed ADH were realized of poured concrete technology. The bearing system consists of a constellation of transverse load – bearing walls thickness of 150 mm, longitudinal wall and pour by poured concrete to the forms at the building site. System also includes prefabricated ceilings and a façade [14]. Façade of LB consists of ceramsite concrete panels of thickness 250 mm. Gable wall consists of 150 mm bearing reinforced concrete panels and of ceramsite concrete panels of thickness 200 mm [14].
Figure 1 Apartment dwelling house of poured concrete system, a) front view and cross-section, b) floor plan [14]

Table 1 Demography of residents [13]

| Demography                  | Number of residents | Number in % |
|-----------------------------|--------------------|-------------|
| to 19 years                 | 303                | 17.6        |
| to 25 years                 | 93                 | 5.4         |
| to 30 years                 | 116                | 6.7         |
| to 40 years                 | 293                | 17.0        |
| to 50 years                 | 229                | 13.3        |
| to 60 years                 | 241                | 14.0        |
| to 65 years                 | 99                 | 5.7         |
| over 65 years               | 352                | 20.4        |
| Total                       | 1724               | 100.0       |

| Demography                  | Number of residents | Number in % |
|-----------------------------|--------------------|-------------|
| Pre-productive age (to 19 years) | 303                | 17.6        |
| Productive age (to 65 years)  | 1070               | 62.0        |
| Post-productive age (over 65 years) | 352                | 20.4        |
| Total                       | 1724               | 100.0       |

| Gender                      | Number of residents | Number in % |
|-----------------------------|--------------------|-------------|
| men                         | 806                | 46.8        |
| women                       | 918                | 53.2        |
| Total                       | 1724               | 100.0       |

The surface area attributable to the apartment dwelling houses is 55 828 m\(^2\). This area is marked in figure 2 by dotted line.

2.2. Suburb Krasna
Krasna is a suburb of Kosice, it is part of the county Kosice IV. The total area of the district city Krasna is 20.05 km\(^2\) and there live approximately 5 000 residents. Population density is 252 inhab./km\(^2\) [15]. The researched territory is 55 800 m\(^2\). This area is marked in figure 4 by dotted line. The average area of land in the solved area is 660 to 810 m\(^2\). Built-up area of the family houses is from 130 to 155 m\(^2\). The number of residents in the house is set to 3, 4, 5.
Figure 2 District city Kosice - Sever
2.3. Variables

2.3.1. District city Kosice - Sever

Specific energy used for heating (SH) was considered as follows: 1 – 141 kWh·m⁻²·a⁻¹. They are existing buildings, built among 1968 – 1975, according to the previous national standards. 2 – 52 kWh·m⁻²·a⁻¹. It means partial renovation. Façade was insulated of thickness 100 mm, roof of thickness 180 mm, windows were replaced for windows with insulating double glazing. 3 – 26 kWh·m⁻²·a⁻¹. It means partial renovation. Façade was insulated of thickness 150 mm, roof of thickness 250 mm, windows were...
replaced for windows with insulating triple glazing. 4 – 15 kWh·m⁻²·a⁻¹. It means comprehensive renovation. Façade was insulated of thickness 180 mm, roof of thickness 340 mm, windows were replaced for windows with insulating triple glazing, application of the unit with the recovery of heat. Specific energy used for domestic hot water production (SHW) was considered as follows: 1 – 22 kWh·m⁻²·a⁻¹, 2 – 16 kWh·m⁻²·a⁻¹, 3 – 12 kWh·m⁻²·a⁻¹, 4 – 8 kWh·m⁻²·a⁻¹. Number of residents contemplated in district city Kosice - Sever: 1724, 2637 and 2817.

2.3.2. Suburb Krasna

Specific energy used for heating (SH) was considered as follows: 1 – 86 kWh·m⁻²·a⁻¹, 2 – 42 kWh·m⁻²·a⁻¹, 3 – 15 kWh·m⁻²·a⁻¹. Specific energy used for domestic hot water production (SHW) was considered as follows: 1 – 24 kWh·m⁻²·a⁻¹, 2 – 12 kWh·m⁻²·a⁻¹, 3 – 8 kWh·m⁻²·a⁻¹. Numbers of residents contemplated in suburb: 210, 280 and 350.

Energy medium: A – natural gas, B – coke, C – coal, D – split fuel wood, E – lump wood, F – electricity, G – district heating, H – electric heat pump, were selected, because they are mainly used in Slovakia.

Factors of primary energy considering the energy medium are as follows: natural gas – 1.10, coke – 1.10, coal – 1.10, split fuel wood – 0.15, lump wood – 0.10, electricity – 2.20, district heating – 0.70, electric heat pump – 0.85 [13].

In the first step, values of the primary energy for each specific energy used (for heating and for domestic hot water) were calculated. It was calculated in consideration of the energy medium. Subsequently in a second step, the values of the primary energy were combined.

**Table 2** The total energy of the solar radiation \( I_0 \) [14]

| Orientation                  | X  | XI | XII | Month| I  | II | III | IV  |
|------------------------------|----|----|-----|------|----|----|-----|-----|
| South                        | 57.2 | 33.1 | 28.4 | 30.2 | 43.6 | 61.2 | 66.3 |
| North                        | 14.5 | 8.4 | 6.8 | 9.1 | 13.8 | 20.1 | 27.2 |
| East, West                   | 32.2 | 15.4 | 11.8 | 14.9 | 24.5 | 42.0 | 59.1 |
| Southeast, southwest         | 44.8 | 24.9 | 20.8 | 22.7 | 33.8 | 50.9 | 62.0 |
| Northeast, northwest         | 18.3 | 9.6 | 7.4 | 10.2 | 16.1 | 26.8 | 41.6 |
| Horizontal                   | 55.0 | 26.2 | 18.4 | 22.2 | 38.6 | 71.4 | 108.2 |

**Table 3** The parameters entering into the calculation [14]

| Month                         | X   | XI  | XII | I   | II  | III | IV  |
|-------------------------------|-----|-----|-----|-----|-----|-----|-----|
| Amount of days                | 31  | 30  | 31  | 31  | 28  | 31  | 30  |
| Average external temperature  |
| in °C                         | 9.8 | 4.3 | -0.3 | -1.8 | 0.4 | 4.6 | 9.9 |
| Desired internal temperature  |
| in °C                         | 20  | 20  | 20  | 20  | 20  | 20  | 20  |
| Hours duration                | 744 | 720 | 744 | 744 | 672 | 744 | 720 |

3. Results and discussions

Table 4 shows the values of the primary energy for each specific energy used and the energy medium for the district city of Kosice – Sever.

**Table 4** Values of the primary energy according to variables

|                    | A     | B     | C     | D     | E     | F     | G     | H     |
|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| **SH**             |       |       |       |       |       |       |       |       |
| 1                  | 155.1 | 155.1 | 155.1 | 21.2  | 14.1  | 310.2 | 109.2 | 112.4 |
| 2                  | 57.2  | 57.2  | 57.2  | 7.8   | 5.2   | 114.4 | 46.9  | 41.4  |
| 3                  | 28.6  | 28.6  | 28.6  | 3.9   | 2.6   | 57.2  | 28.7  | 20.7  |
| 4                  | 16.5  | 16.5  | 16.5  | 2.3   | 1.5   | 33.0  | 21.0  | 12.0  |
| **SHW**            |       |       |       |       |       |       |       |       |
| 1                  | 24.2  | 24.2  | 24.2  | 3.3   | 2.2   | 48.4  | 18.9  | 17.5  |
| 2                  | 17.6  | 17.6  | 17.6  | 2.4   | 1.6   | 35.2  | 14.7  | 12.8  |
| 3                  | 13.2  | 13.2  | 13.2  | 1.8   | 1.2   | 26.4  | 11.9  | 9.6   |
| 4                  | 8.8   | 8.8   | 8.8   | 1.2   | 0.8   | 17.6  | 9.1   | 6.4   |
Table 5 shows the values of the primary energy for each specific energy used and the energy medium for suburb Krasna.

**Table 5 Values of the primary energy according to variables**

|   | A   | B   | C   | D   | E   | F   | G   | H   |
|---|-----|-----|-----|-----|-----|-----|-----|-----|
| SH | 94.6| 94.6| 94.6| 12.9| 8.6 | 189.2| 70.7| 68.6|
|   | 46.2| 46.2| 46.2| 6.3 | 4.2 | 92.4 | 39.9| 33.5|
|   | 16.5| 16.5| 16.5| 2.3 | 1.5 | 33.0 | 21.0| 12.0|
| SHW| 26.4| 26.4| 26.4| 3.6 | 2.4 | 52.8 | 20.3| 19.1|
|   | 13.2| 13.2| 13.2| 1.8 | 1.2 | 26.4 | 11.9| 9.6 |
|   | 8.8 | 8.8 | 8.8 | 1.2 | 0.8 | 17.6 | 9.1 | 6.4 |

Table 6 shows the selected values of the primary energy of the combination 4SH a SHW for each specific energy used and the energy medium for district city Kosice – Sever.

**Table 6 Combination 4SH with types of SHW according to energy source**

|   | A               | B               | C               | D               | E               | F               | G               | H               |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 4SH; A3SHW    | 0.0172          | 0.0172          | 0.0172          | 0.0090          | 0.0085          | 0.0268          | 0.0198          | 0.0146          |
| 4SH; A4SHW    | 0.0147          | 0.0147          | 0.0147          | 0.0064          | 0.0060          | 0.0242          | 0.0173          | 0.0120          |
| 4SH; B3SHW    | 0.0172          | 0.0172          | 0.0172          | 0.0090          | 0.0085          | 0.0268          | 0.0198          | 0.0146          |
| 4SH; B4SHW    | 0.0147          | 0.0147          | 0.0147          | 0.0064          | 0.0060          | 0.0242          | 0.0173          | 0.0120          |
| 4SH; C3SHW    | 0.0172          | 0.0172          | 0.0172          | 0.0090          | 0.0085          | 0.0268          | 0.0198          | 0.0146          |
| 4SH; C4SHW    | 0.0147          | 0.0147          | 0.0147          | 0.0064          | 0.0060          | 0.0242          | 0.0173          | 0.0120          |
| 4SH; D3SHW    | 0.0106          | 0.0106          | 0.0106          | 0.0023          | 0.0019          | 0.0202          | 0.0132          | 0.0080          |
| 4SH; D4SHW    | 0.0103          | 0.0103          | 0.0103          | 0.0020          | 0.0016          | 0.0198          | 0.0129          | 0.0076          |
| 4SH; E3SHW    | 0.0103          | 0.0103          | 0.0103          | 0.0020          | 0.0016          | 0.0198          | 0.0129          | 0.0076          |
| 4SH; E4SHW    | 0.0100          | 0.0100          | 0.0100          | 0.0018          | 0.0013          | 0.0196          | 0.0126          | 0.0074          |
| 4SH; F3SHW    | 0.0249          | 0.0249          | 0.0249          | 0.0166          | 0.0162          | 0.0345          | 0.0275          | 0.0222          |
| 4SH; F4SHW    | 0.0198          | 0.0198          | 0.0198          | 0.0115          | 0.0111          | 0.0294          | 0.0224          | 0.0171          |
| 4SH; G3SHW    | 0.0165          | 0.0165          | 0.0165          | 0.0082          | 0.0078          | 0.0260          | 0.0191          | 0.0138          |
| 4SH; G4SHW    | 0.0148          | 0.0148          | 0.0148          | 0.0066          | 0.0061          | 0.0244          | 0.0175          | 0.0122          |
| 4SH; H3SHW    | 0.0151          | 0.0151          | 0.0151          | 0.0069          | 0.0064          | 0.0247          | 0.0177          | 0.0125          |
| 4SH; H4SHW    | 0.0133          | 0.0133          | 0.0133          | 0.0050          | 0.0046          | 0.0228          | 0.0159          | 0.0106          |

There are min. and max. values of the primary energy according to energy medium. The lowest value is by combination 4SH; H4SHW considering the lump wood (E) 0.0046 kWh·m⁻²·a⁻¹·resident⁻¹. The highest value is by combination 4SH; F3SHW considering the electricity (F) 0.0345 kWh·m⁻²·a⁻¹·resident⁻¹. The difference between these values is 87%. The difference between min. and max. values by each combination in a row is 68%. It is a huge different considering fact, that the building has the same characteristic. The only difference is the energy source! Why? Because of the factor of the primary energy. Each energy source has different factor of the primary energy.

Table 7 shows the selected values of the primary energy of the combination 4SH a SHW for each specific energy used and the energy medium for the Krasna suburb.
Table 7 Combination 4SH with types of SHW according to energy source

|       | A     | B     | C     | D     | E     | F     | G     | H     |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 3SH; A2SHW | 0.1414 | 0.1414 | 0.1414 | 0.0736 | 0.0700 | 0.2200 | 0.1629 | 0.1198 |
| 3SH; A3SHW | 0.1205 | 0.1205 | 0.1205 | 0.0526 | 0.0490 | 0.1990 | 0.1419 | 0.0988 |
| 3SH; B2SHW | 0.1414 | 0.1414 | 0.1414 | 0.0736 | 0.0700 | 0.2200 | 0.1629 | 0.1198 |
| 3SH; B3SHW | 0.1205 | 0.1205 | 0.1205 | 0.0526 | 0.0490 | 0.1990 | 0.1419 | 0.0988 |
| 3SH; C2SHW | 0.1414 | 0.1414 | 0.1414 | 0.0736 | 0.0700 | 0.2200 | 0.1629 | 0.1198 |
| 3SH; C3SHW | 0.1205 | 0.1205 | 0.1205 | 0.0526 | 0.0490 | 0.1990 | 0.1419 | 0.0988 |
| 3SH; D2SHW | 0.0871 | 0.0871 | 0.0871 | 0.0193 | 0.0157 | 0.1657 | 0.1086 | 0.0655 |
| 3SH; D3SHW | 0.0843 | 0.0843 | 0.0843 | 0.0164 | 0.0129 | 0.1629 | 0.1057 | 0.0627 |
| 3SH; E2SHW | 0.0843 | 0.0843 | 0.0843 | 0.0164 | 0.0129 | 0.1629 | 0.1057 | 0.0627 |
| 3SH; E3SHW | 0.0824 | 0.0824 | 0.0824 | 0.0145 | 0.0110 | 0.1610 | 0.1038 | 0.0607 |
| 3SH; F2SHW | 0.2043 | 0.2043 | 0.2043 | 0.1364 | 0.1329 | 0.2829 | 0.2257 | 0.1827 |
| 3SH; F3SHW | 0.1624 | 0.1624 | 0.1624 | 0.0945 | 0.0910 | 0.2410 | 0.1838 | 0.1407 |
| 3SH; G2SHW | 0.1352 | 0.1352 | 0.1352 | 0.0674 | 0.0638 | 0.2138 | 0.1567 | 0.1136 |
| 3SH; G3SHW | 0.1219 | 0.1219 | 0.1219 | 0.0540 | 0.0505 | 0.2005 | 0.1433 | 0.1003 |
| 3SH; H2SHW | 0.1241 | 0.1241 | 0.1241 | 0.0563 | 0.0527 | 0.2027 | 0.1455 | 0.1025 |
| 3SH; H3SHW | 0.1089 | 0.1089 | 0.1089 | 0.0411 | 0.0375 | 0.1875 | 0.1304 | 0.0873 |

There are min. and max. values of the primary energy according to energy medium. The lowest value is by combination 4SH; H4SHW considering the lump wood (E) 0.0375 kWh·m⁻²·a⁻¹·resident⁻¹. The highest value is by combination 4SH; F3SHW considering the electricity (F) 0.2829 kWh·m⁻²·a⁻¹·resident⁻¹. The difference between these values is 87%. The difference between min. and max. values by each combination in a row is 68%.

The difference between the values of primary energy between district city and suburb is 88%. There are min. and max. values of the primary energy according to energy medium. The lowest value is by combination 4SH; H4SHW considering the lump wood (E) 0.0046 kWh·m⁻²·a⁻¹·resident⁻¹ (district city). The highest value is by combination 4SH; F3SHW considering the electricity (F) 0.2829 kWh·m⁻²·a⁻¹·resident⁻¹ (suburb). The difference between these values is 98%.

4. Conclusions

Existing building stock in panel construction provide for the development of housing and requirements for living great potential. It is not currently fed to its actual scope. The goal of the paper was to compare and assess the energy performance of the district city and suburb. Both territories are dealt with in the city of Kosice, in Slovakia. The decisive factor for the final assessment was the global indicator. Global indicator of the energy performance is primary energy. Comparison of the results has been processed for different approaches of renovation (without any renovation, after partial renovation, after comprehensive renovation). Primary energy was calculated and based on comparable unit. The primary energy was accounted for on the built-up area, floor area and number of inhabitants. There were considered 1024 combinations for one score. The results show that the lowest values of global indicator is achieved by using wood. The highest values of global indicator are achieved by using electricity as an energy source. The values of the primary energy according to residents were lower by 98 % in the district city compared to the suburb. The values of primary energy based on the built-up area and the area corresponding to the district city and the suburb were pretty much the same.
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