

**Stanislav ENDEL<sup>1</sup>, Eva WERNEROVÁ<sup>2</sup>, František KUDA<sup>3</sup>****EFFECT OF THE EXISTENCE OF BROWNFIELDS ON SELECTED ITEM  
EXPENDITURE OF MUNICIPAL BUDGETS****Abstract**

The existence of brownfields in an area results in a number of problems. Among others, economic problems are often mentioned. They are mainly connected with negative influence on urban economics, i.e. the total cost of construction and operation of the city. These increased costs are then naturally reflected in the budgets of municipalities burdened by the existence of brownfields. This paper presents the individual items of municipal budgets, which can be influenced by the existence of brownfields, and then examines on a practical example of six Czech towns whether any functional dependence can be found between these items and a number of brownfields in the municipalities.

**Keywords**

Brownfield; municipal budgets; public lighting; municipal waste; greenery.

**1 INTRODUCTION**

The areas of brownfields very negatively affect the overall compactness of the housing development [4,13]. Due to their existence, the city is larger, which lengthens the distance between the individual locations and increases the costs of operation transport and technical infrastructure. The question remains whether the increased costs that are caused by the existence of brownfields within the municipality can be determined using an objective method. One of the possible ways would be experimentally validated method of analysis and subsequent comparison of some items in municipal budgets. The towns of Karviná, Opava, Nový Jičín, Hlučín, Bílovec and Brušperk were chosen for the analysis. All cities are located in the Moravian-Silesian Region of the Czech Republic.

In the first phase, the entire territory of the towns was subjected to thorough research. Given that personal field research of the complete territory of the cities would be quite time consuming, the towns were first examined on the basis of panoramic street images of cities commonly available on the web map servers. On the basis of these images, localities were identified that might be considered brownfield sites, these localities were then explored in detail in person and (non)existence of brownfield and has been directly verified. On the basis of this research, an inventory list of brownfields of the above-mentioned towns was then created. The list includes only brownfields,

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<sup>1</sup> Ing. Stanislav Endel, Ph.D., Department of Urban Engineering, Faculty of Civil Engineering, VŠB - Technical University Ostrava, Ludvíka Podéště 1875/17, 708 33 Ostrava - Poruba, Czech Republic, phone: (+420) 597 321 930, e-mail: stanislav.endel@vsb.cz.

<sup>2</sup> Ing. Eva Wernerová, Ph.D., Department of Urban Engineering, Faculty of Civil Engineering, VŠB - Technical University Ostrava, Ludvíka Podéště 1875/17, 708 33 Ostrava - Poruba, Czech Republic, phone: (+420) 597 321 930, e-mail: eva.berankova@vsb.cz.

<sup>3</sup> Prof. Ing. František Kuda, CSc., Department of Urban Engineering, Faculty of Civil Engineering, VŠB - Technical University Ostrava, Ludvíka Podéště 1875/17, 708 33 Ostrava - Poruba, Czech Republic, phone: (+420) 597 321 934, e-mail: frantisek.kuda@vsb.cz.

whose utilization rate reaches up to 50 % and whose surface area exceeds 100 square meters, including land. Smaller brownfields also certainly negatively affect urban economics of the researched towns; however, it can be assumed that this effect is negligible compared to inventoried areas. The results are summarized in Table 1.

Tab. 1: Comparison of built-up areas and areas of brownfields in the individual towns, [3],

Town	Built-up area [ha]	Brownfields areas [ha]	Brownfields areas portion in built-up areas [%]
Opava	492	22,75	4,62
Karviná	290	108,29	37,34
Nový Jičín	141	31,37	22,25
Hlučín	118	1,56	1,32
Bílovec	80	12,68	15,85
Brušperk	37	5,05	13,65

## 2 ANALYSIS OF THE BUDGETS

The budgets of the individual towns cannot be analyzed in relation to the scope of brownfield areas as units because they contain a wide variety of items totally unrelated to the existence of abandoned sites. Therefore, for the purposes of this study, several items were selected, which were expected to be related to the total built-up area and therefore higher costs due to the existence of brownfields. These are the following items:

- Public lighting, electricity costs – here it is assumed that the larger the built-up areas of the towns, the more public lighting lamps must be installed, which also increases the costs of the supplied energy [2,5].
- Public lighting maintenance costs – in connection with a plurality of public lighting lamps, the costs of upkeep and maintenance of longer lines also increases [2].
- Collection of municipal waste – it can be assumed that costs of municipal waste collection are proportional to the size of the built-up area, and therefore the size of the managed area. In the case of a larger area, it is needed to ensure more staff, more refuse collection vehicles (or to operate these vehicles over longer distances), and also the number or volume of collection containers increases [2,5].
- Maintenance of urban greenery – with a growing area of the town, the extent of mainly small public green areas managed by the town is increasing. The increased range of these areas should logically be reflected in the respective item of the municipal budgets [1].
- Security and public order, the cost of salaries of employees – in this case, they are especially wages of municipal police officers. It is expected that larger area of the town requires more police officers to maintain public order; moreover, brownfield areas are often characterized by increased crime rate [1,2].
- Security and public order, the cost of fuel – the increased crime rate is also linked to a greater number of municipal police trips [1,2].

To determine the specific amounts in the selected items, the final accounts of the individual towns were used from the years 2012 – 2015, namely the Czech Republic Ministry of Finance reports for evaluation of the budgeted balance FIN 2-12 that municipalities normally publish on their websites [6,7,8,9,10,11]. The budgets of the individual towns were not used deliberately, since they can be seen more as plans for the funds, which can be released for the individual items, and then the reality may be considerably different [12]. For this reason, the year 2016 is not included, because its final account was not available at the time of the contribution conclusion. Obviously, the older amounts had to be adjusted due to inflation (given by the Czech Statistical Office) [3]; consequently, it was

possible to determine the average value for each town and each item, and for the purposes of comparison, that average was recalculated per one inhabitant and one hectare of developed areas. The results are summarized in Tables 2 and 3, comparison of the costs and the number of brownfields is then evident from the Charts 1 to 12.

Tab. 2: Comparison of the average costs of public lighting and transport of waste

	Public lighting, electricity [CZK]			Public lighting, maintaining [CZK]			Transport of waste [CZK]			Brownfields percentage [%]
	Average	Per 1 citizen	Per 1ha of built-up area	Average	Per 1 citizen	Per 1ha of built-up area	Average	Per 1 citizen	Per 1ha of built-up area	
<b>Opava</b>	7 906 492	137	16 070	8 218 905	142	16 705	44 120 510	764	89 676	4,62
<b>Karviná</b>	9 405 700	168	32 433	3 726 381	67	12 850	40 374 934	721	139 224	37,34
<b>Nový Jičín</b>	4 806 960	203	34 092	3 134 525	133	22 231	19 216 067	813	136 284	22,25
<b>Hlučín</b>	1 780 463	127	15 089	2 407 959	172	20 406	11 108 278	794	94 138	1,32
<b>Bílovec</b>	1 226 970	164	15 337	715 296	95	8 941	5 331 793	711	66 647	15,85
<b>Brušperk</b>	446 914	112	12 079	178 172	45	4 815	2 422 401	610	65 470	13,65

Tab. 3: Comparison of average costs of maintaining greenery and security

	Public lighting, electricity [CZK]			Public lighting, maintaining [CZK]			Transport of waste [CZK]			Brownfields percentage [%]
	Average	Per 1 citizen	Per 1ha of built-up area	Average	Per 1 citizen	Per 1ha of built-up area	Average	Per 1 citizen	Per 1ha of built-up area	
<b>Opava</b>	7 906 492	137	16 070	8 218 905	142	16 705	44 120 510	764	89 676	4,62
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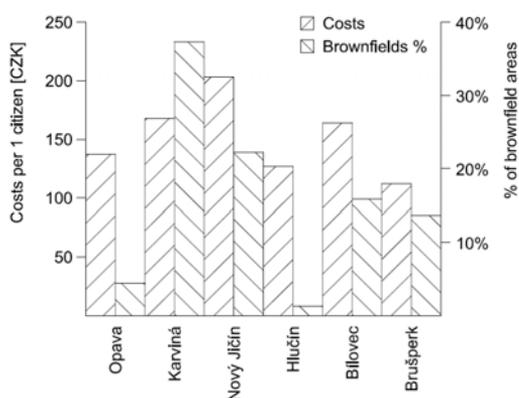


Chart 1: Comparison of the costs of electricity for public lighting per 1 citizen

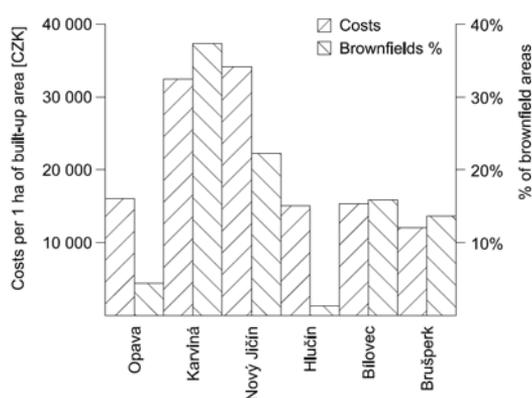


Chart 2: Comparison of the costs of electricity for public lighting per 1 ha of the built-up area

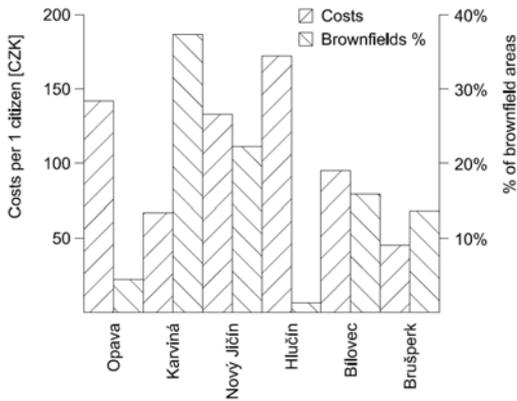


Chart 3: Comparison of public lighting maintenance costs per 1 citizen

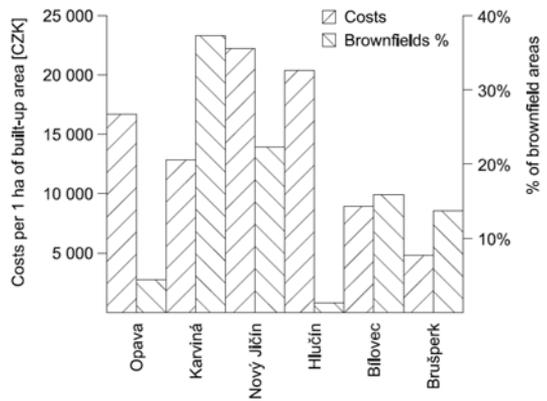


Chart 4: Comparison of public lighting maintenance costs per 1 ha of the built-up area

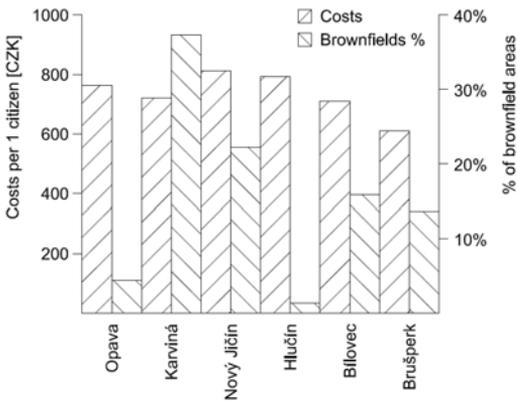


Chart 5: Comparison of costs for collection of municipal waste per 1 citizen

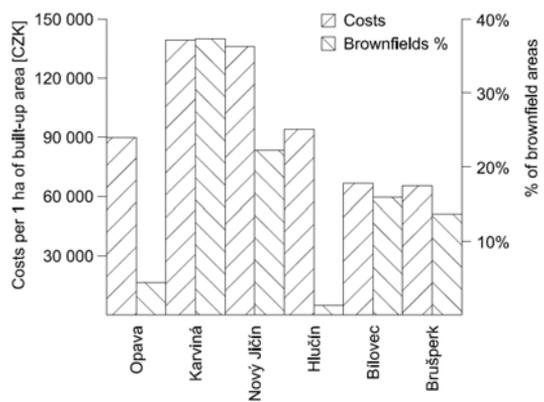


Chart 6: Comparison of costs for collection of municipal waste per 1 ha of the built-up area

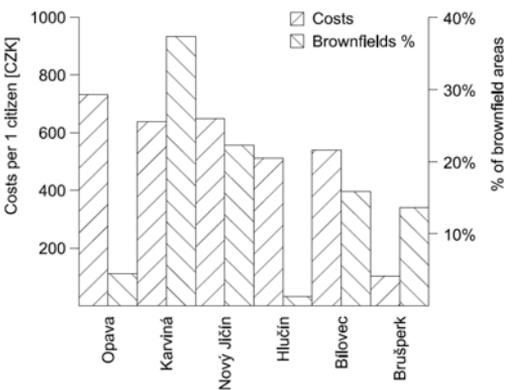


Chart 7: Comparison of greenery maintenance costs per 1 citizen

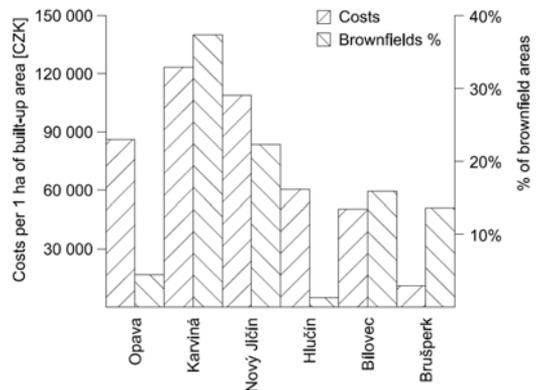


Chart 8: Comparison of greenery maintenance costs per 1 ha of the built-up area

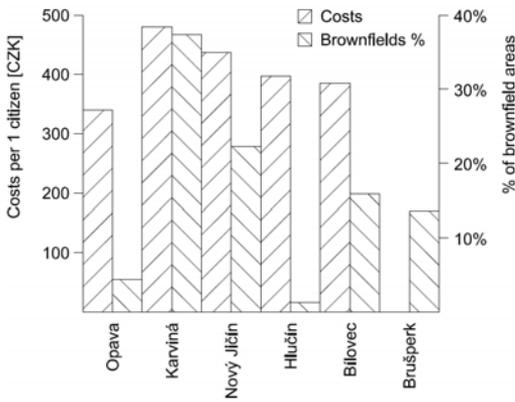


Chart 9: Comparison of costs for salaries of employees taking care of security per one citizen

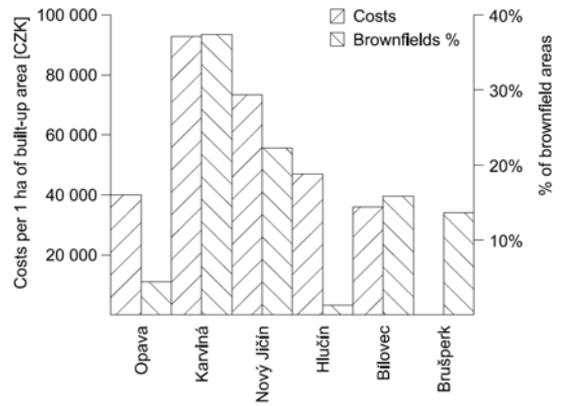


Chart 10: Comparison of costs for salaries of employees taking care of security per 1 ha of the built-up area

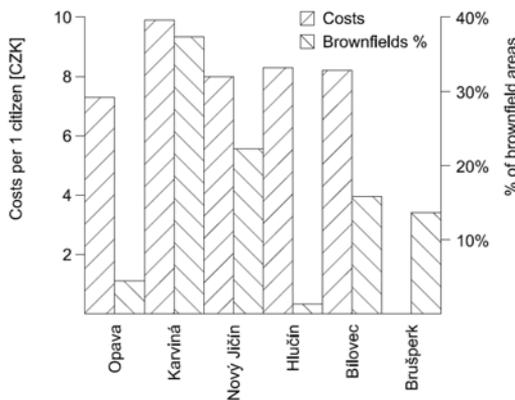


Chart 11: Comparison of the costs of fuel for security forces per one citizen

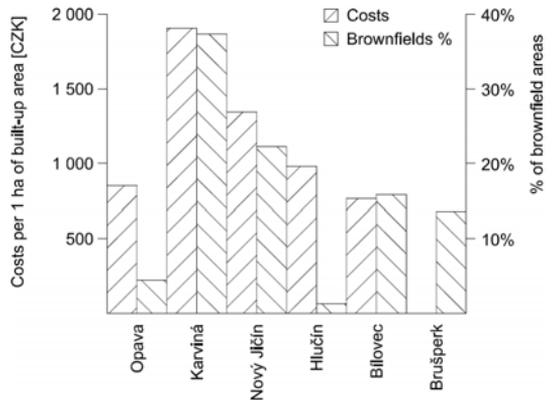


Chart 12: Comparison of the costs of fuel for security forces per 1 ha of the built-up area

The public lighting electricity costs per one inhabitant clearly show that the number of brownfields in urban areas has minimum effect on this item of the final accounts. However, this is quite predictable; since the need for public lighting lamps (and therefore electricity) is based on blanket requirements rather than the population density and population in a certain area (1 hectare of housing development consisting of houses will have similar number of lamps as one hectare of area with high-rise residential buildings). In this case, the data converted to one hectare of the built-up area should be much more revealing. In this case, it is seen that the towns of Opava, Hlučín, Bílovec, and Brušperk have approximately the same unit cost, therefore the amount of brownfield sites does not play almost any role here, while in the towns of Karviná and Nový Jičín, these unit costs are almost double. Although, these are towns with the highest percentage of brownfields in their territory, such a step increase in costs, particularly in the case of Nový Jičín, is somewhat surprising. It can be assumed that, in addition to the existence of brownfields, the situation is affected by many other factors, e.g. different electricity suppliers and contracts with different terms for the supply or use of older, less efficient lighting fixtures.

As regards public lighting maintenance costs, it is obvious that the costs are not influenced by the number of brownfields practically at all. If these costs are recalculated per 1 inhabitant, it is evident that these items become completely different values regardless of the amount of unused land. When comparing the unit costs per one hectare of the built-up area, it is evident that the highest costs

are achieved in Nový Jičín and Hlučín, followed by Opava and Karviná, and finally Bílovec and Brušperk. This sequence is quite different compared to the situation if the towns were ranked according to the percentage of brownfields. The situation can be caused by the use of different types of lighting units of different age and technical condition with different maintenance needs, or different maintenance plans (frequency of lamp painting, their cleaning, replacement of wiring, etc.). In this item, it is not possible to trace any direct impact on the amount of brownfield on unit costs.

An analysis of unit costs for collection of municipal waste per one inhabitant shows that in the researched towns, these costs are about the same, the differences are in the tens of crowns per capita. These small differences are not caused by the existence of brownfields in urban areas – e.g. the town of Hlučín with the lowest percentage of abandoned sites has the second highest unit costs per one inhabitant, while the city of Karviná with the highest number of brownfields has the third lowest costs. However, if these costs are related to one hectare of the built-up area, we can observe a partial dependence of these costs and the amount of brownfield sites in the town. The cities of Karviná and Nový Jičín have the highest unit costs, in the case of Opava and Hlučín these costs are lower by about one-third. Unit costs in Bílovec and Brušperk are lower by about another quarter. In the latter towns, the lower costs are caused mainly by the dominant type of housing development, i.e. houses, and the associated lower frequency of emptying containers for waste, lower number of containers for separated waste, and also lower levels of waste production (growing the inhabitants' own food, the higher the rate of composting, etc.). In other cities with a higher proportion of residential buildings, it can be stated that the number of brownfields in the municipalities is a factor that has quite a significant impact on these costs, and preference of brownfield revitalization to the construction of new buildings on greenfield sites and the associated expansion of built-up urban areas will enable to make these unit costs more efficient and gradually reduce them by up to several tens of percent.

Another item that has been subjected to exploration is maintenance of public greenery. The analysis of unit costs per capita shows that the costs in all cities except Brušperk are very similar and small differences are not caused by the existence of abandoned sites in the researched towns. Again, lower costs in the case of Brušperk are due to the entire character of the housing development dominated by houses and the associated decrease in the need of green and recreational areas in public places. However, if these costs are in relation to one hectare of the built-up area, their partial dependence on the number of brownfields can be observed, similar to the case of municipal waste collection. It clearly shows that the greater the percentage of abandoned sites in a particular town, the higher the unit costs for the maintenance of greenery relative to one hectare of the built-up area. For reasons mentioned above, the towns of Bílovec and Brušperk with lower unit costs deviate again. Again, however, it is not possible for larger cities to trace the exact ratio between brownfield areas and increased costs. Like in the case of the cost of collection of municipal waste, it can be stated that if further urban development will include the brownfield regeneration rather than enlarging the area of urban plans, the unit costs of maintenance of greenery relative to one hectare of the built-up area will gradually decrease.

The last researched characteristics were the costs of the municipal police. In this analysis, the town of Brušperk will not be included in the examined samples, since the town has not established municipal police and expenses under this heading are thus zero. In the case of the other towns and analyses of the salaries of police officers related to one inhabitant, it is apparent that the costs are very similar, however, unlike the other aforementioned items, it can be observed that the differences correspond to the number of brownfields in municipalities, only the town of Hlučín slightly deviates from this trend. If these wage costs are related to one hectare of the built-up area, the situation is similar and the effect on unit costs by the amount of abandoned areas in the towns is quite noticeable. In the case of the cost of fuel for municipal police vehicles, the situation is practically identical. If the costs are calculated per capita, the differences in costs are relatively small, but these differences correspond to the identified percentage of brownfields in the researched towns, again with a slight deviation in the case of Hlučín. In the case of unit costs per hectare of the built-up areas, the situation is even more pronounced. The differences are quite significant and they correspond to the conditions

of abandoned sites; Hlučín again slightly deviates. Based on the above-mentioned facts, it can be concluded that brownfield regeneration can reduce unit costs of running the municipal police, both in the case of conversion of the costs for salaries of police officers, and in the case of the cost of fuel for police vehicles, namely in the order of several tens of percent.

### 3 CONCLUSIONS

The analysis of municipal budgets has shown two facts. The first is that the existence of brownfield areas affects the unit costs per hectare of the built-up area of the researched towns much more than the unit costs per one inhabitant. While in the case of the unit costs per one inhabitant with the exception of the municipal police, in essence, practically no relationship or correlation between those costs and the area ratio occupied by abandoned buildings and premises can be established in either case, in the case of unit costs per hectare of the built-up area, the situation is slightly different. Here we find at least a partial dependence of the costs on the amount of brownfield sites, specifically with items related to waste collection, maintenance of public greenery and security in the town, where the situation is most visible. Of course, we cannot talk about a mathematically definable dependence, or perform calculations of exact additional costs arising for the towns in connection with the existence of brownfields, because, as mentioned above, urban economics is influenced by many other factors and areas of brownfields are only a partial segment.

The second identified interesting fact is the fact that the smallest towns within the conducted research (Bílovec and Brušperk) show lower unit costs in most researched items than other larger cities, especially in unit costs relative to the size of the built-up area, irrespective of the area of brownfields. The cause for this is probably that while brownfields occupy considerably high percentage of the area, the absolute size of the area is relatively small and the municipality operating costs are thus affected to a lesser extent. The second reason could be the lower population; the inhabitants usually live in houses, which eliminates the need to ensure a high standard of services provided (e.g. the frequency of emptying waste containers is usually lower for houses, green areas around houses are maintained by the residents themselves, and total social control and the associated safety in the town in the environment of houses is higher).

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