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Energy-efficient Renovation of a Real Estate in AUSTRIA

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Abstract

An action have cities worldwide, due to urbanization. More than 70 percent of people in Europe live in cities, where 70 percent of the energy consumed. Without adequate measures, a rapidly growing city is at risk in by overloading the infrastructure, threats to water, energy, pollution, logistical bottlenecks and lack of housing. This paper describes an energy-efficient renovation or expansion planning a real estate in Vorarlberg, Austria. The settlement was analysed in more detail here, it involves the city Dornbirn- part Shor. The study investigated how to extend this settlement energy efficient and what feed for factors in the assessment.

Key words: renovation, energy efficiency, urban areas, housing unit.

1 Introduction

The population figures are rising every year, in 2007 already lived 3.3 billion (more than half of the world's population) in cities. Estimates after it is 2050 more than 75 percent, which corresponds to about seven billion people. This means it come new challenges to us. Constantly growing demand for water, energy, food and space. It requires additional land for cultivation, because the energy demand will double. These rapidly rising population figures, it comes quickly to problems in cities. Whether it is the higher energy consumption or even the daily commute and flow is compromised. The human needs are very limited, if these problems are not tackled. Therefore, one must be an early stage with the term "Smart City" deal and plan any further change and expansion targeted efficiently. The sustainable development of cities is a long time in view, however, there are many terms that are currently being discussed: Sustainable cities (Sustainable Cities), Green Cities (Green Cities), eco-cities (Eco Cities), Climate Neutral Cities (Climate Neutral Cities) or Cities of the Future [1, 2]. A clear demarcation of these concepts is very difficult. A "Smart City" may be generally defined as, sustainable, urban post-fossil fuel society. It is primarily about mobility, environment, economy, life and people. It follows that one should conceive a city in which everything possible good works of themselves. In principle, there is a "Smart City" when different quality characteristics are met, this consisted of a number of factors or axes together. On the one hand it depends on the infrastructure of each city on "hard infrastructure", but also for the presence of innovative environmental concepts. As a smart city is also defined cities, which have a high quality of life [3, 4].

2 Optimization and energy performance certificate for settlements

As part of a project at the University of Vienna, an efficient development / extension has been planned for a real settlement. For those planning an energy certificate program was used. The basis for this was an Excel file that placed the province of Lower Austria, Department of Spatial Planning and Regional Policy, available. The following points are included in the calculation:

- **Key figures:** These general data are entered, on the one hand, the land areas and on the other units.
- **Subareas:** The land area is now divided into specific sub-areas. It is important that these areas have the same topography and are not separated by streets, roads, rivers or green spaces. So that the alignment, the building and the way of building the building is the same. Similarly, the faces are filled with residential units.
- **Accessibility:** Output of this point are the development costs. These relate to an internal and external development. The interior contains only the line length of the supply, as well as disposal. The transport infrastructure, water supply, wastewater and storm water, street lighting, gas pipeline and local / district heating are among the external surveying. Generally one can say, the longer the required cables are the higher the cost.
- **Open space quality:** In this point, the partial areas are of great importance, which were elaborated in point two. They provide information on the existing sources of interference and whether there are nearby recreation areas. This means that each sub-area receives its own evaluation point.
- **Connection and Transport:** Here, the partial areas to be considered individually. It is the distance to determine device and authorities respected, there is the part surface in close proximity to the town centre, local shops and kindergarten or elementary school so the rating rises towards more energy-efficient use. There are queried about any distances to the various objectives, but the way to work is not considered. Because he is different from resident to resident (eg home working towards commuting).
- **Location and Community:** On this point, the topography and the building are given, again from each subarea. Likewise, you must specify which alignment exerts the area. Here is one facing away from the access road towards.
- **Evaluation:** The evaluation of the development takes place in three areas: a) Development costs in € per household and per year; b) Affected by the Forms of development of CO_2 emissions from transport per unit and year; c) Location and building quality.

The different points are an individual issue between Class "A" and "G". The value of "A" stands for the most energy-efficient use of resources and "G" is the worst possible rate. Before the final classification is established, each of these results needs to be weighted. The point a) is 0.40, the point b) with 0.25 and the point c) with a 0.35.

3 Energy performance certificate of the current situation

The study area is located in Austria, in the province of Vorarlberg, and it ranks among the largest cities in the country. But as would be too great throughout Dornbirn from the surface and thus also of the individual sub-areas, the study was limited to a part of it. This is located in the western part of Dornbirn and is bounded by the Josef-Ganahl Street, the Lustenauerstraße, the Dornbirn Ach and the Railway Track.

The study area has a total area of 828.630,18 m². Of these, almost 145.298m² of green space. This is again divided into a public area with 45.298 m² and a residential land reserve with 100.000 m² see Fig.1 (right). After the area was accurately determined follows a classification of the subareas. It is important that the topography and a majority orientation of the buildings are the same. The patches should not, however, be separated by streets is this settlement so great that it is hardly possible. This results in 25 divisions, which have different areas and units, see Fig.1, 2 and Tab.1. The existing traffic routes result in a total length of approximately 9.045,24 m, which have an average running surface width of 6 m.

Figure 1: Blue line marks the area investigated, green line indicates the green area

Figure 2: Red lines indicate the partial surfaces with the respective numbering

Table 1: Subareas with surface and housing units

Nr.	Area [m²]	Housing unit	Nr.	Area [m²]	Housing unit
1	13.558,53	5	**14**	38.754,16	32
2	12.286,44	4	**15**	19.711,56	19
3	14.385,85	12	**16**	24.115,90	35
4	13.385,73	8	**17**	16.174,01	30
5	8.614,08	7	**18**	23.471,45	22
6	11.672,08	2	**19**	26.665,13	25
7	28.001,01	14	**20**	20.926,58	16
8	15.859,10	35	**21**	15.655,63	15
9	27.376,71	27	**22**	57.638,62	61
10	14.918,31	16	**23**	28.490,56	36
11	23.707,36	20	**24**	25.471,53	28
12	18.226,37	15	**25**	7.564,69	18
13	34.625,68	37			

The outer and inner development includes the line length of the supply, transport infrastructure, water supply, electricity supply and gas line length. In this settlement, the overall classification of the energy efficiency class is at the level "G", which belongs to the worst rating class. Thereafter, the classification of the quality of open spaces follows. This is however not taken into account in the classification of the settlement gives you a rough estimate of the area to the well-being of residents. With the presence of private garden areas and a low noise source within 150 meters a very good rating is achieved. The whole settlement has to be classified as class "C".

The next weighting point b) includes a detailed description of the respective subareas. This includes how far they are from different clues. This represents a sum of CO_2 emissions Transport / Housing unit / year of 0.26 t / Housing unit / year. A satisfactory level in the overall scale "D". The last item c), which has a weighting of 0.35 in the calculation, is the quality of the location and building. As can be seen from the name already, while the topographic location of each subareas flows with. These are all in one plane. Also, the building is one, which is divided in four different selections: the family house open or coupled, row house and multi-story building. The last unknown for the evaluation, is an alignment of the respective subareas. To define this precisely, the direction indicated by the opposite side of the road, respectively. In our settlement has reviewed this point the class "B" and is thus the highest grade in the weighting of the classification. From the now calculated evaluation points results in an overall classification of the actual status with the E class and is thus in the poorer half, see Fig. 3.

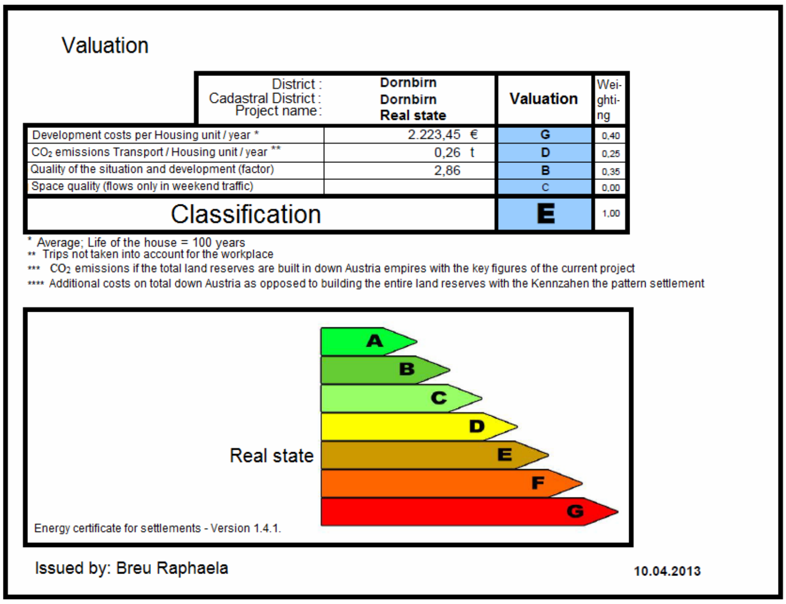

Figure 3: Energy Performance Certificate of the actual state

4 Study of alternatives

After drawing up the energy performance certificate, which refers to the current situation, trying the energy-efficient use was increasing. It was particularly important that it does not come to a huge redevelopment of the area, such as a fully coming relocation the houses or the complete modification of existing road profiles. In the following points, two different variants were elaborated.

4.1 Variant 1

First, the various points were considered more accurate assessment. This shows that the development cost per unit per year received with the greatest weighting. Looking at the energy certification of existing territory, this point meets a relatively bad grade. In order to change this situation, the interior and external development must be revised or other construction areas will be added. In the first point, the line length, transport infrastructure, water supply, electricity supply, street lighting and gas pipe length are incorporated. The problem with these points is that actually no greater redevelopment the territory is deliberate. In order to change these different surveying, the lengths must be shortened. This can only be accomplished if road courses changed or entire houses are built differently on the connection.
But belongs to another selection increasing the construction area. Since 100.000 m² residential land reserve are available in the area studied, this point will be expanded. There are two new faces, with 17.886,89 m² to 16 residential units and 24.969,23 m² to 28 residential units, inserted. Thus, the reserve is reduced to almost 57.000 m². As this new construction areas require a connection to the transport network, a new road is being built. This causes an increase of the transport length by approximately 567 m. Thus, there are still a green area and an optimal extension of the residential area, which means that there is hardly any change of the cityscape. However, this small increase in residential units has no improvement on the energy stage of development. In detail from Dornbirn - Schoren, there are about 539 residential units with the expansion increases the number to 583 housing units.

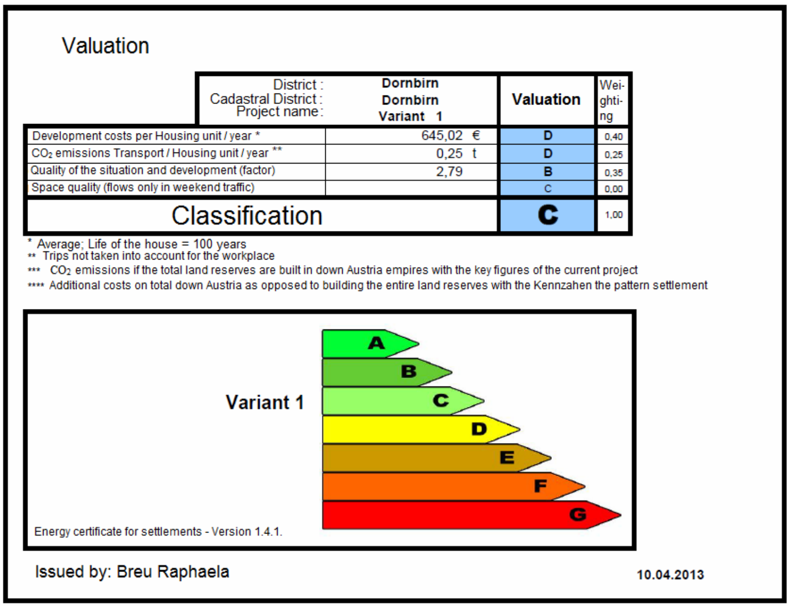

Figure 4: Energy Performance Certificate of the variant 1

As can be expected with an ever-increasing population, the area is taken into consideration with a triple extension. By this step, the development costs per unit are reduced from 88.376 to 25.000 €. With this large reduction automatically increases the energy efficiency of this point to three stages, thus it is now in the review at level "D". The remaining calculations no increases were effected. Thus, the following points in the final classification are: point a) for Class "D", point b) also reached the Class "D" and point c) flows with the classification "B". With the increase of residential units is also better rating. This increases the area to the total level C and thus lies in the green zone. This indicates that a good energy-efficient use of resources is available, see Fig.4.

4.2 Variant 2

As a further variant to improve the energy-efficient use, remains to change CO_2 emissions and the quality of the location and development. The second point is relatively difficult to rework because the settlement area can be laid badly from the flat topography in a mountain range. Equally impossible is a new obstruction to assume because the area is already present and it is not in order is a new development. If therefore in future a settlement be built, these points must be considered from the outset, since they cannot after the construction be changed or can change very difficult and costly. This means, for the second variant, the CO_2 emissions will be influenced so that takes us to a higher rating. Currently, this is a step "D" and is thus only in the central region. To change this, the following points can be changed. It is by a length specified by the various sub-areas.

Working day (except Saturday):

- To centre
- The nearest local shops
- The playground / green space
- To nursery school

Saturday, Sunday and holidays:

- The Green Room > 1500 m²
- For recreational or cultural facility
- For sports or playground > 500 m².

Because of this settlement, the centre is far away from almost every part surface of at least 1500 m, a reduction of 500 m is assumed. This could be realized, in assuming that the existing border area is located with the same building near the city limits. By this measure, an improvement of the individual sub-regions of one or two steps can already be caused.

The next improvement point which is situated in the list, is the distance to the nearest local shops. The study area is part of a major city and the local shops are on average 1500 m far away. If one were to ensure that each sub-region is not more than 1000 m is far away, so again there is a small increase in results. With these two improvements can be attained an increase in performance of Dornbirn, part Schoren, from level "D" at level "B". This is an increase of two whole steps, in words of a satisfactory energy-efficient use of a scarce good on energy-efficient use. Can therefore be seen with a certain consideration of settlement construction, a relatively good utilization can be achieved.

The remaining calculations no increase was effected, thus the output sheet can be calculated with the respective weightings.

- Development costs per flat / year: Level "G"
- CO_2 emissions Transport / GR / year: Level "B"
- Quality of the situation and Community: Level "B"

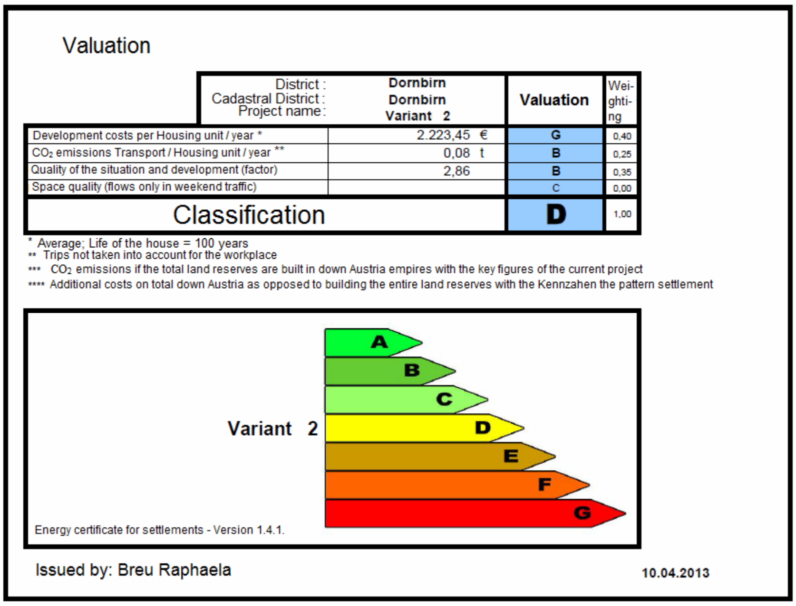

Figure 5: Energy Performance Certificate of variant 2

With this improvement in CO_2 emissions from transport, the area rises to an overall level D and thus lies in the yellow range. This indicates that a satisfactory energy-efficient use of resources can be seen, see Fig.5.

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