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# SMART CITIES – PILOT PROJECT SMART PRAGUE

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## Abstract

The capital city of Prague has put forward its own concept of development called SMART PRAGUE 2014 - 2020. It concerns a long-term concept of economic, technologically effective and sustainable development supported by the use of sophisticated and integrated data. In order to designate targets in the area of SMART infrastructure there was carried out a case study involving a sample of 20 buildings in the city. Sources of energy were identified and current patterns of energy consumption were worked out and analysed. This enabled the proposal and evaluation of measures leading not only to reduction of energy demand but also to improvement in the quality of the internal environment. The contribution has the purpose of making known the results of this case-study in which the Faculty of Civil Engineering was a participant.

Maximum length of the abstract is 300 words and must not be exceeded. It is highly advised there should be only one paragraph in the abstract, but it is possible to use more paragraphs.

**Keywords**

Smart cities; Prague; primary energy; cost

## The support of „Smart Cities“ from European funds

The European Commission adopted a "Partnership Agreement" with the Czech Republic in August 2014, setting down the strategy for the optimal use of European Structural and Investment Funds throughout the country. The agreement provides the prospect for investments amounting to €22 billion in total Cohesion Policy funding 2014-2020. The Czech Republic also receives €2 billion for rural development and €31 million for the fisheries sector.

It states in this document that the Czech Republic is among the countries with an above-average energy demand economy when compared with other EU countries. Regarding energy consumption and the accompanying pollution the conceptual solution of these issues is therefore considered beneficial through the concept „smart city“, i.e. interconnected measures for energy savings at municipal level. In the Czech Republic the urbanization level is 73 %, and therefore the majority of inhabitants can suffer negative impact. The integrated projects which can be implemented by means of various co-ordinated instruments have exactly the kind of substantial potential required for creative synergies. An integrated combination of support across an energy efficiency area, ICT and transport (so called Smart Cities) or other interventions put in place on the basis of a coherent set of goals in an area, can provide an example of significant synergy.

The framework for potential support from European funds within the named projects for *Smart Cities* has been generated by this statement. The Czech Republic has specifically created the necessary space in the so-called *Integrated operational programme*, where it formulates the Thematic aim 4: *The support of a shift towards the low-carbon economy in all branches* and as an investment priority: *The support of energy efficiency, intelligent systems of energy management and using the energy from renewable resources in public infrastructures, over and above other concerns in public buildings and in housing.*

In 2014 the capital city Prague, in harmony with the European strategy and the *Partnership Agreement*, started preparation of the concept *SMART Prague,* the essential vision of which is to support effectively and systematically in Prague the development and interconnection of a quality energy, telecommunication, transport and environmental infrastructure, including education, culture and entrepreneurship with a high added value.

## Methodology

In the professional literature we find several definitions of the term S*mart Cities.* Let us introduce two here, the first one representing a more academic view and the second one more recognizable to the general public:

- Smart City denotes a developed urban area that nurtures sustainable economic development and a high quality of life by excelling in multiple key areas; the economy, mobility, the environment, people, everyday living, and government. Excelling in these key areas can be done through strengthening human capital, social capital, and/or ICT infrastructure [1].
- The second definition is presented by the climate strategist Boyd Cohen: “Smart cities use information and communication technologies in order to be more intelligent and efficient in the use of resources, resulting in cost and energy savings, improved service delivery and quality of life, and a reduced environmental footprint--all supporting innovation and a low-carbon economy.”

There exist several approaches on how to evaluate a city from the viewpoint of the environment e.g:

- *city **innovation** economy classifications and rankings*, 2014 [2] (in this evaluation Prague was placed 62nd out of the 445 evaluated cities in the world, the first place belonging to San Francisco – San Jose, USA),
- *rankings of the **quality of life** of cities*, 2014 [3] (Prague according to this rating was placed 45th out of 113 evaluated world cities, in first place being Canberra, Australia),
- the *rankings of **green cities*** [4] (according to the *Green city index* Prague was placed 24th in a European rating, the first place taken by Copenhagen).

*Boyd Cohen* published in the web pages of *Co. Exist* a 2014 research survey *The Top 10 Smart Cities in Europe.* He developed a set of ideal indicators (28) to be used for benchmarking and ranking smart cities. Here is a city ranking according to his *Top Ten Smart Cities in Europe [5]*:

- Copenhagen
- Amsterdam
- Vienna
- Barcelona
- Paris
- Stockholm
- London
- Hamburg
- Berlin
- Helsinki

Copenhagen is a very ambitious city. For example according to the ratings of *The Green City Index 2014* Copenhagen's residential buildings consume almost 40% less energy than the Index average. Over the period 1993 to 2010, greenhouse gas (GHG) emissions per capita in Copenhagen decreased by 40 % from 7.31 $tCO_2e$ to 4.38 $tCO_2e$ [6]. Currently Copenhagen has one of the lowest carbon footprints per capita in the world. Copenhagen also has the most ambitious carbon reduction plan to achieve carbon neutrality by 2025 [7]. In 2013 it was recognised in the category *Carbon Measurement and Planning* of the *City Climate Leadership Awards [8].*

Carbon dioxide emissions, the main contributor to global warming, are set to rise again in 2014 – reaching a record high of 40 billion tonnes. *The Global Carbon Budget 2014* shows that global $CO_2$ emissions from burning fossil fuel and cement production grew 2.3 per cent to a record high of 36 billion tonnes of $CO_2$ in 2013. Emissions are projected to increase by a further 2.5 % in 2014. In 2013, the ocean and land carbon sinks respectively removed 27 % and 23 % of total $CO_2$ leaving 50 % of emissions in the atmosphere [9].

## Why specifically metropolitan regions?

Today, approximately 359 million people (72 % of the total EU population) live in cities, towns and suburbs. Although the speed of transformation has slowed down, the share of the urban population continues to grow, and is likely to reach more than 80% by 2050 [10].

67 % of Europe's GDP is generated within metropolitan regions, while their population represents only 59 % of the total for Europe. A comparison of economic performance across European cities indicates that the major cities are doing better than the rest [11] and capitals and larger metropolitan regions have performed better during the economic crisis than smaller metropolitan and non-metropolitan regions [12].

Many global environmental challenges can also be best solved in cities. Thanks to their more optimum conditions they can significantly contribute to energy consumption controls and to $CO_2$ emissions reduction: indeed the density of urban areas actually enables using energy in more efficient forms for housing and transport [13].

# SMART Prague

The capital city Prague is economically by far the most developed region of the Czech Republic and a center beyond only regional significance. As such it contributes in a significant sense to the development of competitiveness and economic growth in the Central European region. It provides a dense network of public services not only for the citizens of Prague but also for all citizens of the Czech Republic. It is also a centre of education because it is the headquarters of two-thirds of all science and research institutions in the country and within its own boundaries it accounts for 40 % of all expenditures in the Czech Republic [14].

The concept SMART Prague is a modern urban concept the basic vision of which is effective and systematic support for the development of a high quality urban infrastructure, enterprising activity with a high added value and the development of education and culture in the city.

Within the framework of the concept SMART Prague there have been determined a number of priority axes:

- SMART Infrastructure
- SMART Specialization
- SMART Creativity

Within the framework of the axis SMART Infrastructure there has been prepared a project for the revitalization of buildings held in ownership by the city itself. Selected buildings will be transformed into intelligent buildings, the goal of which is to maximize savings on natural resources or to improve the internal environment of buildings. For achieving this goal there have been allocated means from Operational Programme Prague – Growth Pole of the Czech Republic, and within the framework of energy savings and buildings transformation into intelligent buildings, these amount to CZK 2 billion [15].

## Pilot Project SMART Buildings

In cooperation with the Institute for Planning and Development of the Capital City of Prague, company ECOTEN Ltd. and the Czech Technical University there was carried out a study of the potential for the transformation of selected buildings into intelligent buildings. 20 buildings were selected for the pilot project:

- 8 basic and secondary schools
- 11 buildings for social services
- 1 administrative building

These buildings were selected to fulfil the required basic criteria:

- The building is in the ownership of the capital Prague,
- Cooperation is assured with the academic environment,
- High level of turnover among people,
- Groups of buildings in the immediate neighbourhood,
- High potential for savings,

- High potential of experience transfer into other buildings,
- Logical continuity for further measures of Smart Prague.

There was analyzed the current energy consumption and energy sources for these buildings. On the basis of requests from users and building caretakers there were proposed measures leading not only to reducing the nature of energy demand but also to improving the quality of the internal environment. Owner requests were directed to introducing intelligent buildings principles, i.e. for automatic heating management, heating for hot water, lighting, and ventilation [16].

The following measures were proposed for all buildings regarding their technical condition and use such as:

- Insulation of the building envelope
- Replacement windows and doors
- Installation of forced ventilation - recuperation
- Renewable sources of energy
- Energy efficient lighting
- Shielding objects
- Use of rainwater
- Dealing with drinking water
- Waste management
- Integration of Building Management System
- Security
- Building Information Modeling
- SBToolCZ - certification of green buildings

All measures were individually priced for each building and there was calculated the energy consumption savings and operational costs. The resulting investment value reached CZK 1.25 billion. In the following Figure 1 one can see the survey of investment costs for the transformation of individual buildings.

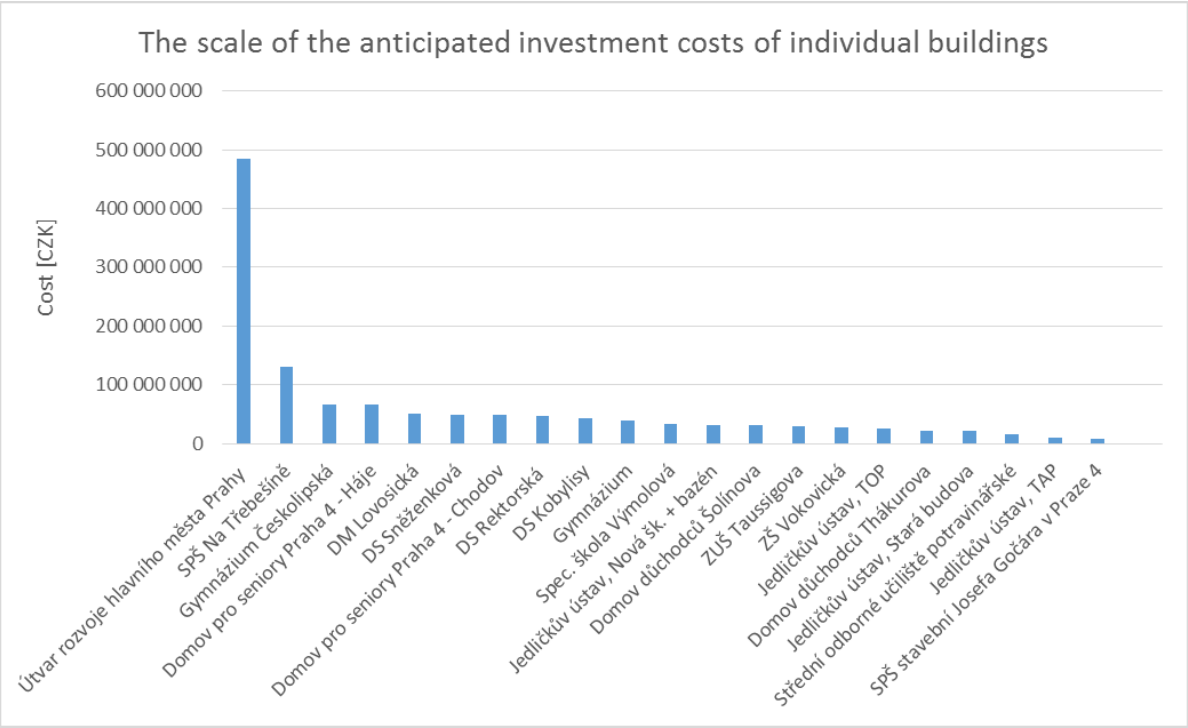


**Figure 1: The scale of the anticipated investment costs of individual buildings**

Regarding the high number of buildings it was necessary to set criteria for their selection into the pilot project: savings in operational costs, investment return potential, effectiveness and many others.

Later there are introduced the most significant criteria.

In the following Figure 2 there are depicted anticipated savings on primary energy for individual buildings. Buildings in a bad technical condition with the largest flooring area which have so far not undergone any fundamental reconstruction brought the highest savings. With these buildings, because of their technical condition, it was desirable to carry out reconstruction. On the basis of this primary recommendation the technical requirements were investigated in more detail and real possibilities of implementation and financing were evaluated.

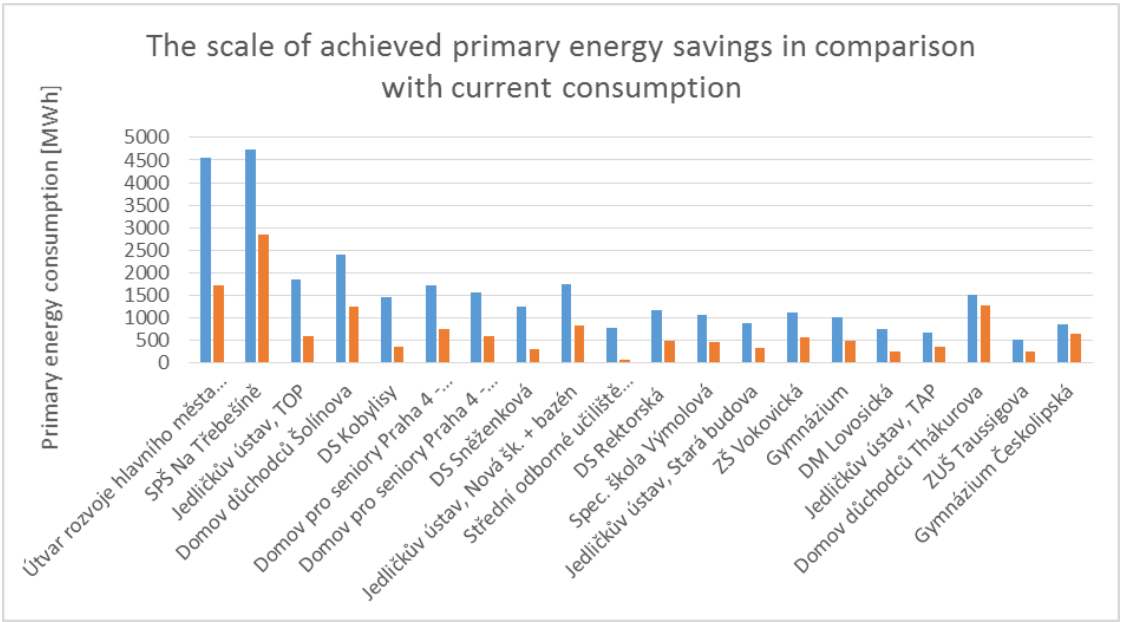

**Figure 2: The scale of achieved primary energy savings in comparison with current consumption**

One further criteria for the particular selection of a building appropriate for such implementation is the effectiveness of the measures. This is the ratio between the achieved primary energy saving and investment costs. This criterion objectively evaluates imposed costs on 1 GJ of the primary energy. This proportional indicator is not distorted by the size of a building as it is in the previous case – see Figure 3.

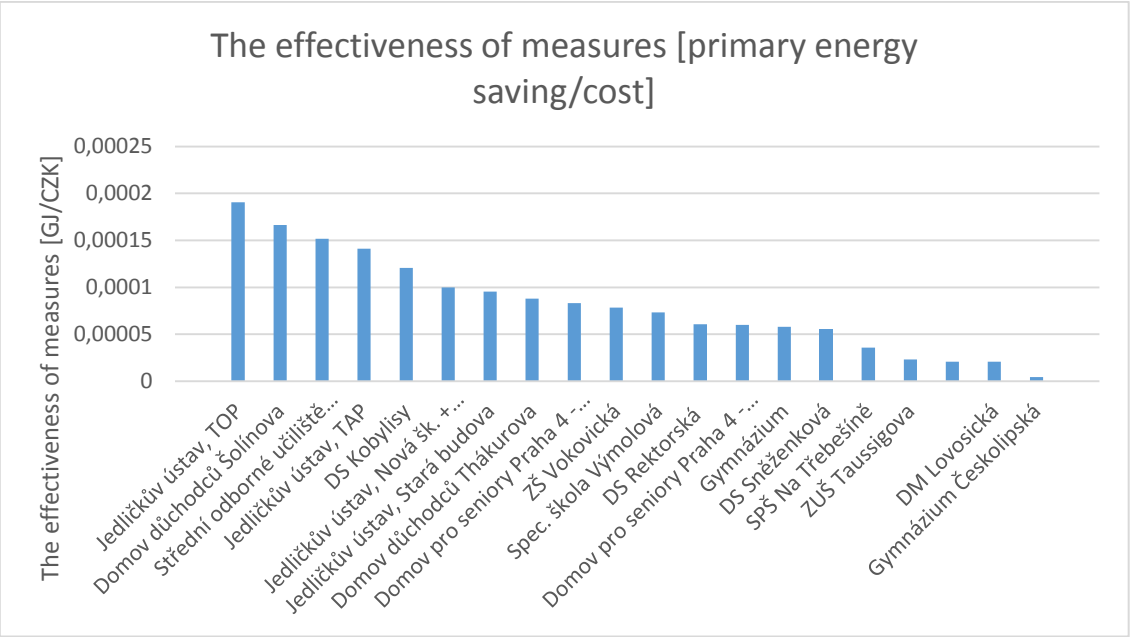


**Figure 3: The effectiveness of measures (primary energy saving in the conversion to CZK 1 of the investment)**

The Jedlička Institute building is from the viewpoint of effectiveness seen as the most successful, i.e. it achieved energy savings per 1 investment crown.

# Conclusion

The Czech Republic is among the countries with an above-average energy demand economy when compared with other EU countries. Regarding energy consumption and the accompanying pollution the conceptual solution of these issues is therefore considered beneficial through the concept „smart city“, i.e. interconnected measures for energy savings at municipal level.

The capital Prague within the updating of the strategic plan of the city, a territorial energy concept and others development strategies, took up the project SMART Cities. The concept SMART Prague is a modern urban concept, the essential vision of which is an effective and systematic support for the development of a high quality urban infrastructure, enterprise with a high added value and the development of education and culture in Prague. Within the framework of the priority axis SMART Infrastructure there has been implemented a project SMART Building, where the buildings are transformed into intelligent buildings, such as schools, homes for social care and administrative buildings. Prague can use for financing this resources from the Operational Programme Prague – Growth Pole of the Czech Republic, where there is allocated the amount CZK 2 billion. This pilot project will serve for gaining experience for yet further implementation not only in Prague but also in other towns in the Czech Republic.

The next project development will focus on the evaluation of the economic benefits of carrying out particular transformation into intelligent buildings. Within the existing and future cooperation of IPD Prague and the CTU there is provision for evaluating particular implementations additionally

creating a common methodology for the selection of appropriate buildings for transformation into intelligent buildings. Specialists from the IPD in Prague, UCEEB and the CTU are working on further research regarding the pilot project SMART Building.

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