WP 3.1.2

Potential estimation regarding energy efficiency and users' habit

PP4 – Prague Metropolitan District 11

April 2012

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Introduction

For determination of possible improvement energy efficiency and users' habit were selected 15 public buildings, owned by Town District of Prague 11.

Consumption of heat in selected buildings

Total heat consumption by these selected 15 public buildings was in 2010 ca. **22849,51 GJ** (data based on EA), emission of CO2 amounted to **2042,08 ton/year.**

In 12 public buildings source of heat for heating and hot water is district heating system of plant Mělník conduit. 1 public building has the boiler gas for the heating and preparing of hot water.

In 2 public buildings source of heat for heating is district heating system of plant Mělník conduit and for preparing of hot water is used the gas boiler.

Characteristics of the heating plant

Thermal energy from heating plant Mělník is used to heat approximately for one third of Prague.

Mělník power plant is close Prague - located about thirteen kilometers below the confluence of the Labe and Vltava. It consisted originally of three technological units built gradually between the ends of the sixties and seventies as complex condensing power plants burning brown coal transported by trains from both North and West Bohemia mines.

Mělník power plant provides in addition to production of electricity and supply of heat. Both commodities are produced in the joint, so-called combined cycle, leading to significantly higher fuel efficiency and thus energy savings with a positive impact on the environment.

Heat is supplied heat line to the town of Mělník and the village of Horní Počaply and customers on site and nearby power plant. The total annual supply is approximately 500 units at max output of 80 MW. Options power plants are much higher, because the turbines can remove the cumulative heat output up to 340 MW.

Characteristics of buildings

These are buildings that were built in 80-90 years of last century. The vast majority were built in the panel technology VVÚ-ETA.

VVÚ-ETA - cross system spans 3.0 and 6.0 m. The cladding consisted of parapet panels and Fireplace inserts. The insulation consisted of 80 mm polystyrene. The system is characterized by the strip windows.

*Short construction description of panel technology VVÚ-ETA***:**

-structural system of transverse load – bearing walls, modules 3,0 a 6,0 m

- overall height floor 2,8 m

- internal bearing components of concrete, thickness. 190 mm

- concrete ceiling panels, thick. 190 mm

- staircase in single-module 3.0 m and staircase in double

for houses with 4 NP in module 6.0 m

- elevator shaft mounted, located next to the one-armed stairs

- perimeter load-bearing concrete panels layered, thick. 240 mm, 290 mm after revision

- peripheral non-structural facade cladding, suspended, in variants solved: reinforced concrete panels layered, thick. 190 mm, 240 mm after the revision, sill panels and fireplace layered, thick. 190 mm, after revision 240 mm reinforced layered, thick. 240 mm, 290 mm after revision

- hanging and recessed loggia, circuit components of concrete, thickness. 230 mm

- flat roof with single and double casing

- partition panels Siporex or Promont, thick. 60 and 80 mm thick reinforced concrete 80 mm.

Previous reconstruction

Since 2002 is gradually reconstructions. In the reconstruction mostly is to:

• insulation roofs,

• insulation cladding,

• replacement of windows,

There are the following objects:

- ES Milíčov, object „C“ – eating object
- ES Milíčov, pavilion A2

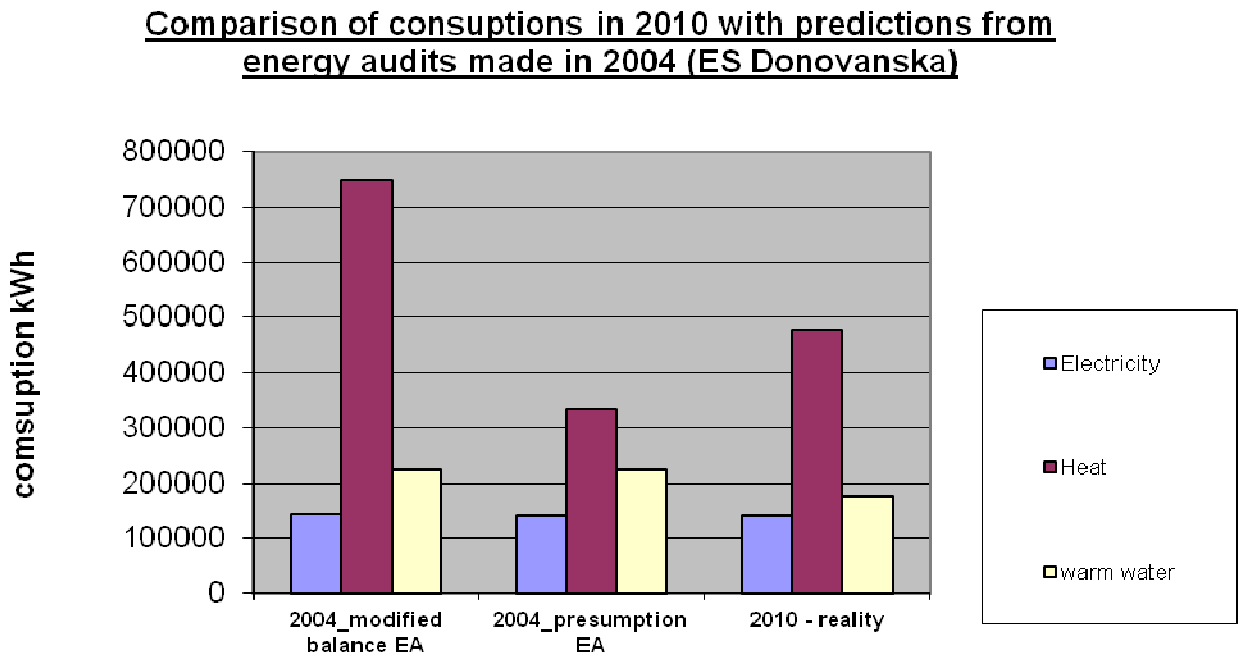
- ES Mikulova, pavilion H and I
- Care home Šalounova
- Culture center Malenická
- ES Donovalská
- Socio-nursing facilities with catering and DOMOVINKA Janouchova
- ES Ke Kateřinkám
- KG Hrabákova
- KG Mírového hnutí
- KG Hroncova
- KG V Benátkách
- KG Konstantinova
- KG Křejpského
- KG Dubnova

(ES – Elementary School, KG – Kindergarten

Methodology of the potential estimation calculation

The used methodology is based on comparison consumptions of heating energy presumed by energy audits and real consumptions energy in given object. The difference between presumption and reality is caused by wrong or missing balancing of heating systems, wrong setting of control heating systems, imperfect using of heating and ventilation including inconvenient users' habits.

Figure 01. Example of comparison consumption before renovation, prediction of energy audit and real consumption



Detailed study

Evaluation of energy difficulty of public buildings and possibilities of improving energy efficiency

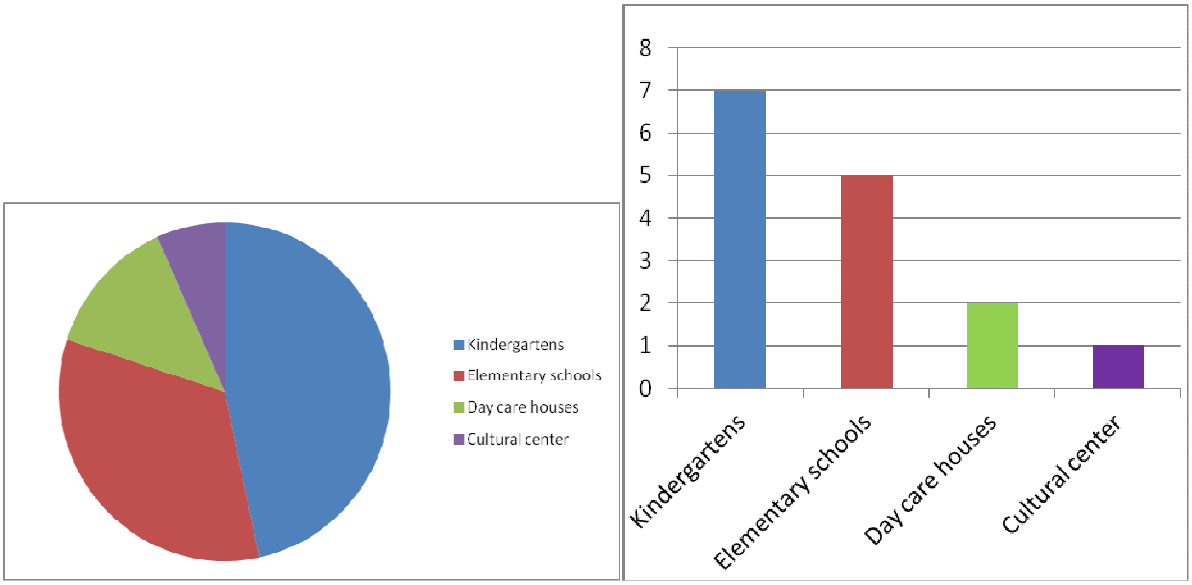
The main results of the heating energy consumption of the City District Prague 11 in 2010:

Number of public buildings:	15	buildings
Total heating energy consumption:	6 347 075	kWh/year
Total floor area of the buildings:	37 586	m2
Average heating energy consumption:	423 138	kWh/year public building
Average floor area of the buildings:	2 506	m2/average public building

Table 1. Average and summarized result values from 15 audits

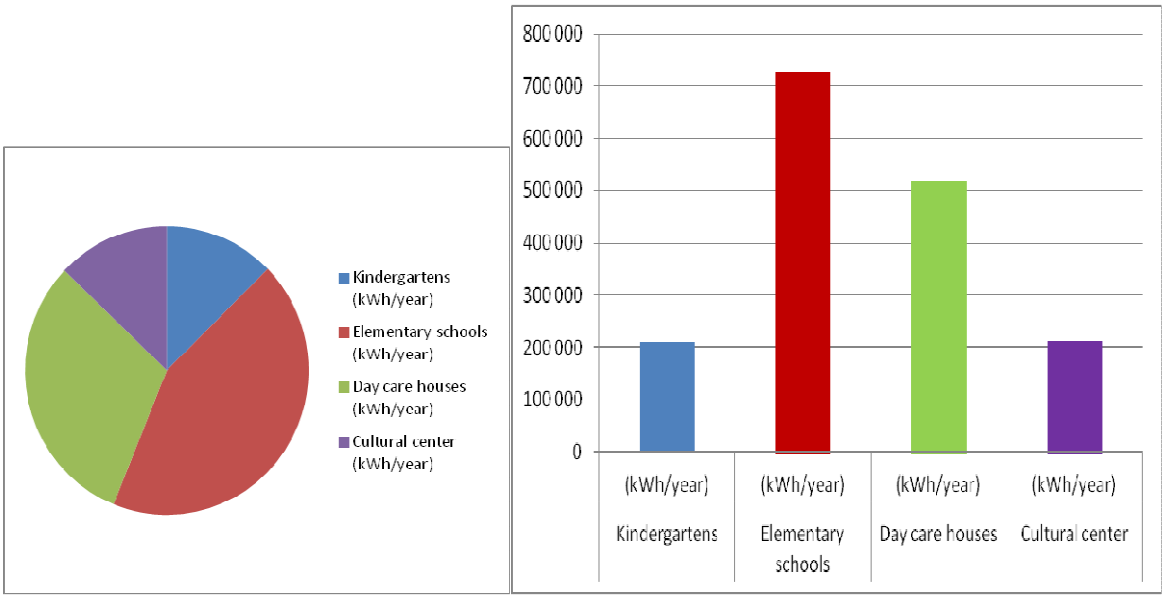
	Floor area	Heating energy consumption
	m2	kWh/year
Average	2 506	423 138
Sum	37 586	6 347 075

Figure 02. Number of the different public buildings [p.]



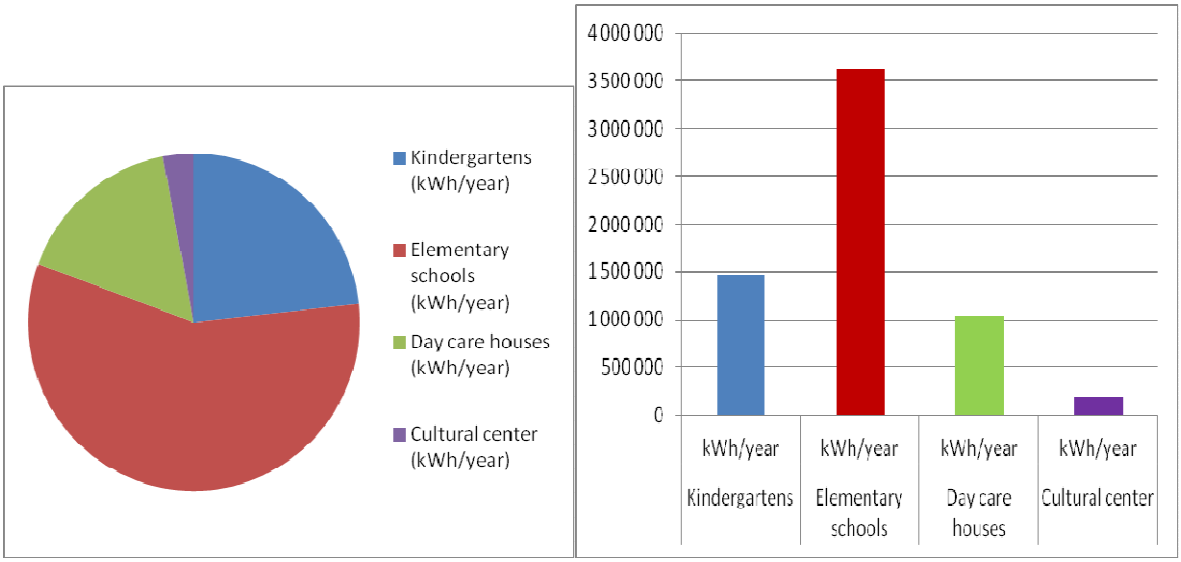
Kindergartens	7
Elementary schools	5
Day care houses	2
Cultural center	1

Figure 03. Average heating energy consumption of the different public buildings [kWh/year]



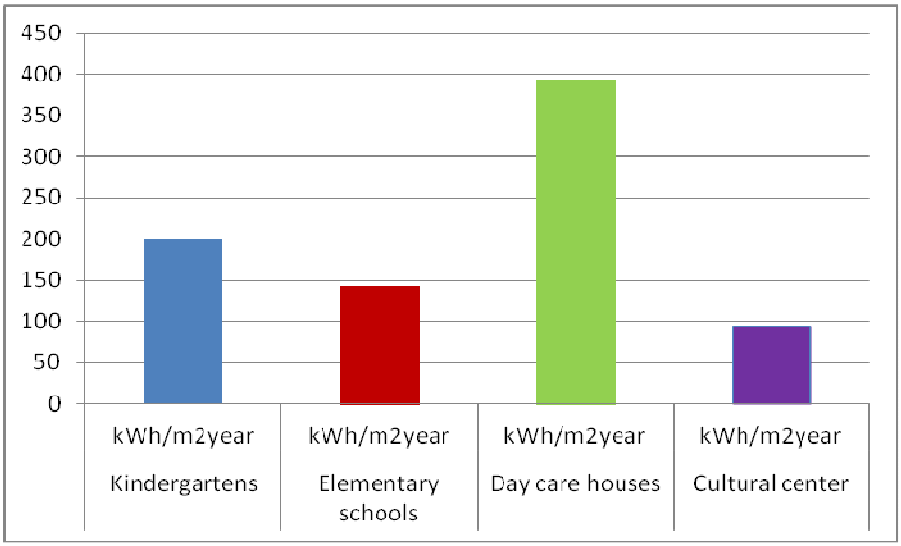
	Kindergartens	Elementary schools	Day care houses	Cultural center
	kWh/year	kWh/year	kWh/year	kWh/year
Average	210 133	725 564	517 192	213 944

Figure 04. Summarized heating energy consumption of the different public buildings [kWh/year]



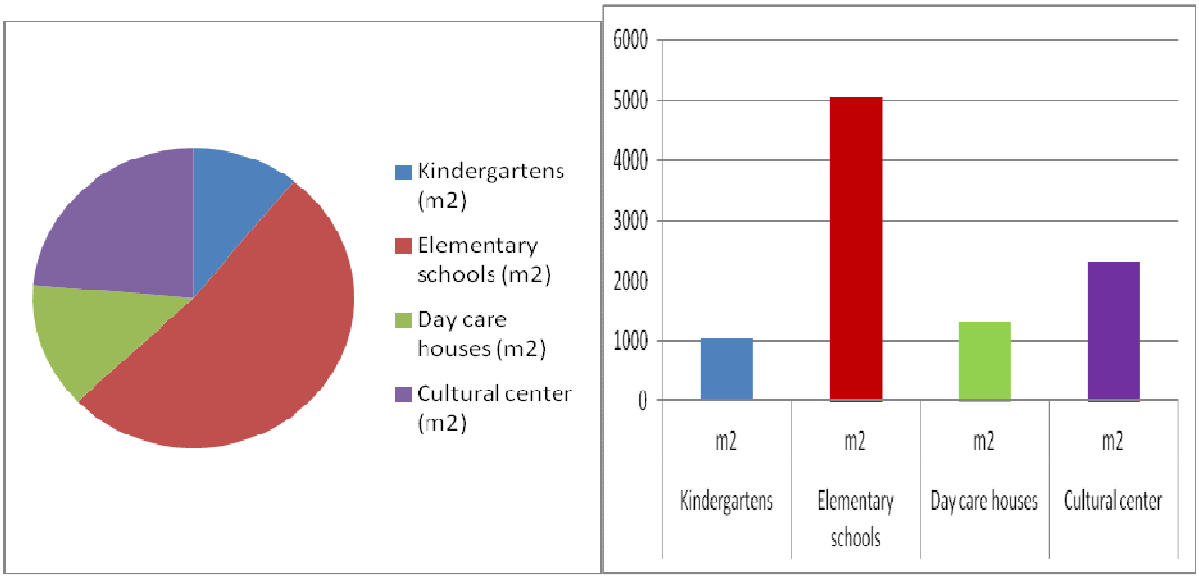
	Kindergartens	Elementary schools	Day care houses	Cultural center
	kWh/year	kWh/year	kWh/year	kWh/year
Sum	1 470 928	3 627 819	1 034 383	213 944

Figure 05. Average specific heating energy consumption of the different public building [kWh/(m2year)]



	Kindergartens	Elementary schools	Day care houses	Cultural center
	kWh/(m2year)	kWh/(m2year)	kWh/(m2year)	kWh/(m2year)
Average[1]	201	143	394	93

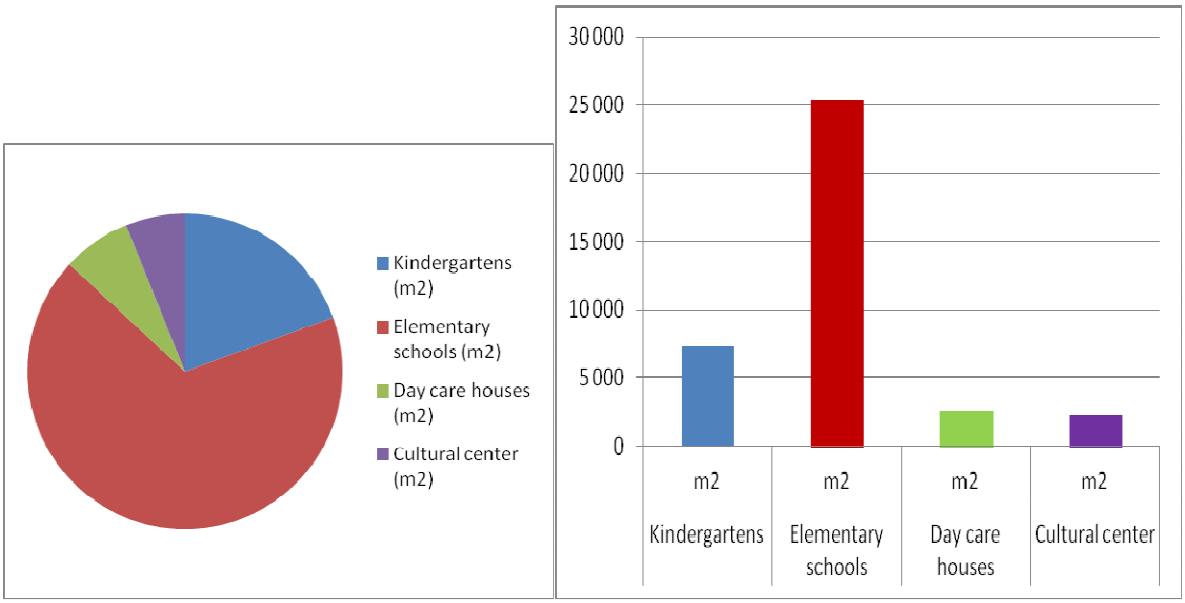
Figure 06. Average floor area of the different public buildings [m2]



	Kindergarten	Elementary school	Day care house	Cultural center
	m2	m2	m2	m2
Average	1045	5070	1314	2296

[1] Calculation: Average heating energy consumption (kWh) /Average floor area (m2)

Figure 07. Summarized floor area of the different public buildings [m2]



	Kindergartens	Elementary schools	Day care houses	Cultural center
	m2	m2	m2	m2
Sum	7 312	25 352	2 627	2 296

Summary

The main problems of public buildings in terms of energy

- Low thermal insulation resistance of building structures (walls, roofs, floors, windows)
- Obsolete energy distribution without regulation as an annual, day and time use (attenuation, heating control, a reduction of temperature distribution, better insulation of hot-water)
- Inadequate maintenance of all equipment
- Obsolete lighting system based on thermal light sources
- Low use of RES
- Savings in consumption (water, electricity, induction cooking)

Since the 2002 are gradually regeneration the public buildings. Mostly to:

• insulation roofs,

• insulation cladding,

• replacement of windows,

• replacement of exterior doors,

• replacement of lighting with fluorescent.

We have the data about the heat consumption from some building also for the year 2003 and this can be compared with the year 2010. In 2003 we have data about heat consumption from 12 public buildings.

Table 2: Real heat consumption of 12 public buildings for the years 2003 and 2010

	Heat consumption in GJ
reality 2003	20 690,96
reality 2010	18 635,38

Source: energy audits

In the table we can see, that the heat consumption was decreased in GJ and this specifically about 2055,58 GJ. One of the reasons of decreasing heat consumption is gradual reconstruction of objects.

Potential savings in CO2 emissions in public buildings

The greatest potential for energy savings in public buildings, school type (large and colorful pavilions) are in their heating. Therefore, the greatest importance for the energy savings with them especially during the reconstruction of reducing the heat transfer envelope (walls, roof and window areas) and infiltration (ventilation - tight plastic box or in conjunction with heat exchangers air) or control (attenuation) according to the annual heating and daily periods and use of rooms and habits of users (heating and fall off the lights when leaving). Significant is also the highest utilization of waste heat from both electricity generation and from municipal waste incineration.

Other measures in this respect are minor, although not significant, for example the replacement of thermal light sources (lamps) discharging (fluorescent lamps and, recently, LEDs) and time control.

On the other hand, the use of renewable energy sources (particularly solar thermal collectors) in specific cases at low prices on hot water heat from the plant Mělník (waste heat from power generation and incineration of municipal waste) and the impossibility of their use during the holiday season (summer and winter) is not in the public buildings the school type economic. For the same reasons, has no meaning or use of heat pumps, if it was not associated with the necessity of running air conditioning in the summer holidays for other alternative uses for these buildings. Meaning it would only use flat roofs of pavilions for the installation of photovoltaic panels with the right to purchase electricity utility.

Total real achievable energy savings and CO2 can be expected in case of school buildings in values over 30% of the economic return in 20 years.

User habits

The questionnaires 'C' profile completed by public buildings implies the following.

1. Indoor environmental quality

- users are among the important areas of particular noise, artificial lighting, natural light, change of air and the overall condition of the building.

2. Individual areas

    a. Heat

In buildings with temperature ranges from 20 ° C or more. In most buildings there is a manual control of heat. Users, however, perceive the chill in the premises, especially in winter months. The negative factor is the limited use of automatic temperature regulation. Other common mistakes include users is the heating, which is not turned off in unused meeting rooms and open doors to unheated rooms.

b. Air-conditioning

Surveyed public buildings are not equipped with the air conditioning.

c. Water

As far as saving equipment by the taps, so in some buildings are in some not. Users are being kind when using water.

d. Electricity

The public buildings are manually controlled artificial lighting and user habits are positive - users switch off lights when sufficient light, do not leave lights after working hours.

Computers, printers and copiers users after working hours turn off and don't let them in standby mode.

e. Good practices

In this area, surveyed users behave very economically and ecologically - use recycled paper, print double-sided and multiple pages on one, sort kitchen waste for recycling.

As a positive existence assess vault allows users to ride bikes to work by bicycle, which some of them are used. Bicycle storage offering only a few public buildings. Other users get to work by public transport, on foot or by car.

From the evaluated questionnaires show that users of public buildings tend to conserve energy. But there are areas where it could reduce public spending by changing user habits:

• turn off heating in unused meeting rooms,

• closing the doors to unheated rooms,

• equip-saving devices in faucets those buildings which are not yet saving devices,

• change the mode of transportation to work - use public transport instead of cars.

Further recommend:

- automatic using of heat regulation managed by central information system,
- installation of motion sensors for control of lighting in the hallways.

Table 2. Summary of objects

	PP4 - Prague
Total number of public buildings	15
Number of public educational buildings	12
Number of public office buildings	-
Number of public residental buildings	-
Number of other public buildings	3