Czech-Austrian Winter and Summer School

Smart Cities: State of the Art and Comparison

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Abstract

The goal of the work is to compare two smart city projects – one in the Czech Republic and one in Austria. There is only one smart city project in the Czech Republic named the Smart Region Vrchlabí. The Austrian reference project is the Smart City Hartberg which is very similar when it comes to the number of inhabitants. This fact guarantees optimal comparability. The results of the comparison lead to a conclusion concerning the individual concepts and standards of the two countries.

In order to compare the projects several criteria have been selected and contrasted to each other in a table. Based on the findings it can be stated that the standard of smart cities in Austria is further developed than in the Czech Republic. The concept and idea of smart cities in the Czech Republic focuses on technological matters, whereas in Austria the term is additionally extended to social and ecological levels. In order to picture the situation in the whole EU-28, this work contains information on various chosen smart city projects of other European Union members, as well.

Key words: smart city, Hartberg, the Smart Region Vrchlabí, shared spaces, renewable energy

Content

Introduction

Nowadays, there are many aspects that push the development of power engineering forward. As a consequence of that, the energy industry is forced to adapt. One of these aspects is the implementation of smart technologies into the electrical power grid. This development is triggered by the increase of the share of volatile renewable energies which only feed into the grid when they are available. In order to maintain reliable energy supply along with the required quality, smart technologies coordinate the demand and supply of the energy system. This development is necessary due to environmental factors such as reducing the CO_2 emissions or increasing energy efficiency. Issues that come along with that situation comprise for instance the implementation of e-mobility, the expansion of smart metering, island operated micro grids, or combined heat and power cycle plants.

In order to gain knowledge and to enable a sustainable energy future a lot of developing work needs to be done when it comes to smart cities. Smart technologies and sharing information concerning their appliance are necessary for smooth cooperation of the worldwide grids. This information needs to contain for example facts about successful operation or ineffective technologies. Furthermore it serves to prevent the system from a global blackout.

The goal of the work is to compare one specific smart city project in the Czech Republic to another one in Austria. In order to gain findings about that topic the work contains a theoretical and a practical part and is divided into three sections.

The first section focuses on the important definitions related to smart cities. Moreover, other smart city projects in the EU 28 are introduced and elaborated in this section. An elementary part is stating the reasons for the comparability of the two chosen individual projects.

The second section consists of two chapters. Chapter one describes the pilot project for smart technologies in the Czech Republic – the Smart Region Vrchlabí. Chapter two describes the selected smart city project in Austria – The region Hartberg.

The third section represents the practical part of the seminar work. In this part the two described projects are compared. The obtained data are used as a source of stating the possible benefits for other European countries.

1 Smart cities - definitions and overview

1.1 Related definition

In the beginning of the work there is a necessity to introduce some important terminology and the legal basis concerning smart cities. The main pillar of the EU's energy and climate policy became The SET-Plan (The European Strategic Energy Technology Plan). It is meant to be a first step for stating an energy technology policy for Europe and the European Union adopted it in 2008. This plan concerns two major timelines. The first step is to obtain the 20 – 20 – 20 goals which include a 20% reduction of CO2 emissions, a 20% share of energy from low-carbon energy sources and a 20% reduction in the use of primary energy by improving energy efficiency by 2020. The other major track leads to the goal for 2050 which is limiting the global temperature rise to a maximum of 2 °C. This goal is meant to be reached especially by matching the vision to reduce EU greenhouse gas emissions by 80 – 95 %, lower the cost of low-carbon energy and make the EU's energy industry growing in the low-carbon energy technology sector. The SET-Plan became a main stimulus for the Czech Republic to consider the implementation of smart technologies, grids and cities in general. (What is the SET Plan?, 2015)

First of all the adjective *smar*t needs to be defined. Smart is the term that stands for "Self-Monitoring Analysis and Reporting Technology". The main usage is to protect and prevent errors. (SMART, 2015) Such a technology monitors and analyzes hard drives and then lets the operator know in case there is a problem. This kind of technologies is used to build a *smart grid*. It is the system that controls electricity demand in a sustainable, reliable and economic manner. Such a grid helps to balance the electrical consumption with the supply and enables a high share of decentralised renewable energy systems. Furthermore, a smart grid enables the integration of energy storage devices and the use of electric vehicles. In case of system errors it helps to restore the supply of electricity. On the whole it provides environmental benefits such as reduced peak demand, integration of more renewable power sources and reduction of CO_2 emissions and other pollutants. (What is a smart grid, 2015)

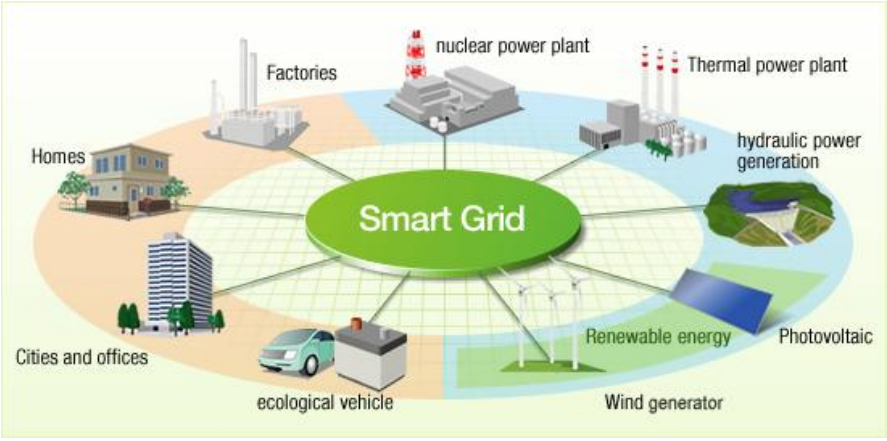

Figure 1 - Smart Grid chart [source: http://www.hitachi.com/environment/showcase/solution/energy/smartgrid.html /2015)]

A *smart city* is a developed urban area, using smart technologies connected to the smart grid. It provides high quality of life by excelling in economy, mobility, environment, people, living and government. If an area includes more than one city it is called a *smart region*. (Smart City, 2015)

Due to the particular projects which are described in detail below it is appropriate to mention *shared space*. It is about the special urban design with the object of minimization of demarcations between vehicle traffic and pedestrians by removing curbs, traffic signs and regulations or road surface markings. (Shared space and shared surface designs need further definition and evaluation, say practitioners, 2015)

Another term that needs to be defined is *island operation*. It is the technical condition in which there is no electric power provided by the electric utility. Only a local decentralised generator is powering a separated area. (Víte, co to je a jak funguje ostrovní systém?, 2015)

1.2 Juridical basis

In order to define and work with term *smart city* the legal basis in the different countries needs to be stated.

1.2.1 Legislative background in the Czech Republic

Although the laws allowing smart regions and cities to be established are complex and influenced by many parameters there is one major juridical basis in the Czech Republic which is the Czech State Energy Policy. Its update concerning smart cities was taken into account by the Czech government in the beginning of 2015. This particular document is formulated as a political, legislative and administrative frame for reliable, affordable and sustainable energy supply. It contains the energy priorities for the next 30 years and includes many possible ways how to implement some of the smart features. (Veřejném projednání Aktualizace státní energetické koncepce , 2013)

1.2.2 Legislative background in Austria

In order to achieve the climate goals stated in the directives of the European Union, the "Klima - und Energiefonds" (climate and energy fund) has been established in Austria. It is an institution that has the goal to coordinate the governmental subsidies to reach a zero emission society by 2050. The climate and energy fund is owned by the ministry of environment and infrastructure of Austria. The existence of the climate and energy fund is

based on the "Klima - und Energiefonds" - law of 2007. All smart city regions in Austria are part of the smart city program, coordinated by the climate and energy fund. Thus also Hartberg is being subsidised by the climate and energy fund. The subsidy budget from 2007 to 2014 was 934 million Euros and 76000 projects have already been financially supported. For 2015 a further budget of 126 million Euros was granted by the Austrian Republic. (Klima - und Energiefonds, 2011)

1.3 Smart city projects in the European Union

In Europe, there are many projects concerning smart cities. A selection of several pilot projects is listed below.

In Italy government regulations on the mandatory installation of smart meters have been in force since 2006. The goal was to equip 95% of the households with smart meters until 2011. By the date of publication of this work 32 million Italian households have been upgraded with a smart metering system. This equals about 85% of all consumers. The energy company Enel is preparing a smart grid pilot demonstration project in the south of Italy. The main goal is to try the active controlling of decentralized power consumption and running the distribution grid at high voltage level. The project will involve about 8 000 customers and decentralized sources, especially photovoltaic and wind power plants.

In Spain the energy company Iberdrola has launched a pilot project in the region of Castellón close to Valencia in 2010. About 100 000 households in this region have already been equipped with smart meters. The project is using low and high voltage level in the distribution system using multi-level approach to deploy smart metering. The energy company Endesa in 2009 launched a four year pilot project Smart City in Málaga.

In Germany, a consortium of companies and universities in Karlsruhe launched a pilot project to build a smart grid in the industrial region of Karlsruhe-Stuttgart in southern Germany under the name MERIGIO in 2009. The project involves 1 000 customers from households, industrial enterprises, production and storage units. Also in Mannheim, a smart grid pilot project is implemented called Model City Mannheim (MoMa). Other projects are launched by large distribution network operators (e.g. E.ON or RWE). Projects concerning smart grids are generally strongly supported in Germany, not only by the population but also by the government.

In March 2010 in France, ERDF Distribution Company has launched various smart grid pilot projects in two regions involving 300 000 households. Within 2012 to 2017, 35 million French households are about to be equipped with smart meters. ERDF also runs a large project with a new architecture in the level of Low voltage and Medium Voltage distribution networks in the suburban area of Nice. The project includes the following aspects:

- Integration of local production resources
- Testing the concept of active demand response

- Units of electrical energy storages
- Testing the infrastructure of charging stations
- Smart building concepts called smart homes.

(Evropský kontext, 2015)

1.4 Reasons for choosing the two particular projects

In this part the particular reasons for choosing the reference projects are stated and explained.

1.4.1 The Smart Region Vrchlabí

The Czech Republic is like every EU member state obligated to fulfil the 20-20-20 commitment. A dominant electricity producer ČEZ, a. s. is the parent company of the CEZ Group. This group of 120 companies produces, distributes and sells the electricity in the Czech Republic, Poland and several Balkan states. ČEZ, a. s. is one of the six major distribution companies in Europe that made a consortium and set off the project Grid4EU. This project laid the foundation for the development of power grids. In 2009 the CEZ group introduced the FUTUR/E/MOTION and under the auspices of this project, the decision was made to test the most modern smart energy technologies in the distribution system. About four particular areas were considered. Due to the several criteria the micro-region Vrchlabí has been chosen. These criteria were:

- Proper size for the intention of the pilot project
- There are many potential renewable resources that could be implemented into the distribution system
- The place is suitable to establish combined heat and power generation units and in conjunction with this it is possible to exploit business opportunities of central heat supply
- Vrchlabí is located nearby the Giant Mountains National Park so it is an ideal area to test ecological impacts of smart technologies on nature
- An automobile manufacturing plant of ŠKODA a. s. is located closeby, so it is suitable to implement an electric mobility element
- Without the innovative and friendly attitude of town leaders it would not be possible to carry out the project.

(Rychterová, 2014)

1.4.2 The Region Hartberg

In order to compare and evaluate the Czech smart city region Vrchlabí, a region suitable for a comparison in Austria needed to be found. In order to get significant results the two regions should have similar structures. The number of inhabitants is the parameter that matters most. For example a small region like Vrchlabí does not have neither the need nor the financial means for a metro system. That fact makes bigger regions or regions that belong to a bigger city like Vienna Aspern to a suboptimal choice.

After research on the webpage www.smartcities.at a proper region was found and elected to compare. The east Styrian district capital Hartberg was judged highly suitable due to the following reasons:

- The urban region Hartberg (the town and its surroundings) is inhabited by approximately 12 500 people which equates the size of Vrchlabí
- The town structure is similar to hundreds of other European cities - historical city centre with old listed buildings, grown structure, industry, residential areas and shopping centres at the edge of the city
- Hartberg is one of the official smart city regions in Austria that get subsidies from the "climate and energy fund"
- There are already smart city measures done, e.g. shared spaces, city bus, photovoltaic fed carport and district heating
- The environmental consciousness of the residents seems to be quite high - this fact is reflected by a lot of indicators. Hartberg won for example the "Styrian township of the future" award 2015, there are "sustainability competitions" like the energy saving competition called "Energy hunt" and a bike week. Furthermore Hartberg aims to obtain complete CO_2 neutrality within the next decades.

2 Description of the projects

2.1 The Smart Region Vrchlabí

In this chapter the pilot project Smart Region Vrchlabí is described in detail.

2.1.1 General overview

Vrchlabí is a town located in the north east of Bohemia and its altitude is 477 metres above sea level. It is usually called The Gateway to the Giant Mountains, the highest mountains in the Czech Republic. Its location is alongside the river Elbe. Vrchlabí has about 13 000 residents and the town was founded in the fourteenth century.

Vrchlabí is a very touristic resort not even in winter for winter sports but also in summer when people come there to hike. Vrchlabí has to meet ecological standards because it is located right at the boundary of the Giant Mountains National Park. Vrchlabí is connected to the Czech capital Prague by a direct bus connection which departs several times a day each day of the week. The journey time is about two hours. There is also a train service that connects Vrchlabí with Prague.

Vrchlabí is self-sufficient from a lot of points of view. There are several supermarkets along with many groceries, five kindergartens, two elementary schools, a gymnasium (high school), a well-known district hospital, a fire station, a police station, all kinds of authorities, all kinds of banking systems and several manufacturing plants of many types of industry branches. (Vrchlabí)

The realization of the Smart Region Vrchlabí has been planned to be carried out within the years 2010 to 2015.

The roll-out of the project is divided into three major phases. The preparatory phase was held from 2010 to 2012. The implementation phase started in 2012 and is expected to be finished by the end of 2015. Currently the project is in the testing phase which is about to be completed by the end of 2015.

2.1.2 Smart region features already done

The testing of many elements is included in the project such as the following:

- Automation for high voltage level
- Monitoring for high voltage level

- Implementation of the concept of protecting the High voltage switchgear using protocol IEC 61850 and Generic Object Oriented Substation Events messaging (GOOSE messaging)
- Full automation of low voltage level in selected parts of the network (Regulatory Impact Statement equipment cabinets)
- Implementation of the concept of balanced area and operation (island operation)
- Power management via low voltage outlets in Distribution System, energy optimization
- Controlling of the local sources of production, including the use of accumulation
- Implementation of smart meters
- Self-healing functionality through superstructure control system (automatic reconfiguration)
- Monitoring the impact of charging stations for electric mobility on the distribution network
- Usage and testing the suitability of different types of data transfer technologies to control the systems

The installation of smart meters and communication equipment has been among the first actions initiated in the smart region project. Their purpose is to obtain and transfer the information about the behaviour of the distribution system. This kind of technologies is tested in various ways to transfer data. In the area called Liščí kopec the innovation of seven distribution transformer stations have been evaluated.

The most significant change was the unification of the grid voltage to 35 kV which has been completed by 2014. The residents may have noticed the exchange of high voltage cables and laying of pipes for optical cables. With the launch of laboratory testing communication technologies in TTC Techkom Centre in Prague it was possible to test new technologies in the distribution system. These technologies comprise island operation automatics and telecommunication technologies like WiMAX. Testing in the lab was underway during the years 2012 and 2013.

In June 2012 the company ČEZ Energo started the first cogeneration unit of the type TEDOM QUANTO D770 in Fügnerova Street. The used fuel type is natural gas. The unit has a rated electrical power of 800 kW and a thermal power of 911 kW. The heat is supplied to a district heating system in Vrchlabí operated by the company Teplo Krkonoše. The generated electricity is feed into the distribution grid. In the summer of the same year the construction of two other units was completed. Both units are the same type, namely TEDOM QUANTO D1600 with the electric power of 1560 kW and 1720 kW thermal power. Due to the use of combined heat and power the efficiency of the plants is up to 90 %. The entire unit is located in an acoustic cover to avoid noise emissions. One of the units with an electric power of 1560 kW also serves as a source of power in case of island operation. The unit is dimensioned to maintain the energy supply of the area Liščí Kopec and the local hospital in case some error in distribution system occurs.

The last element of the pilot project that is worth mentioning is the inclusion of e-mobility into the distribution system. The goal is to contribute to raise the public awareness about emission-free transport. Vrchlabí is the sixth town in the Czech Republic in which an electric charging station was established. As a symbolic sign the town leaders have been provided with the Peugeot iOn electric car.

In order to guarantee the operation of the distribution station, a functional communication between the installed control unit of the charging station and the control centre is required. The distribution system has to be capable of response to the current demand of energy of the charging station. The goal is to measure the quality of energy for recharging and find out how the power supply network is affected. The display on the charging station shows where, for how long and how much customers use the charging station. (Rychterová, 2014)

2.2 The Region Hartberg

2.2.1 General overview

Hartberg is located in the east part of Styria. The closest bigger cities are Graz (around 75 km) and Vienna (around 130km). Hartberg is situated at the highway A2 which is one of the main highways in Austria that connects Vienna with Graz. Furthermore it is connected with some major interregional roads and has a train connection to Wiener Neustadt.

The urban region Hartberg consists of the town Hartberg, Hartberg surroundings, St Johann and Greinbach. Figure 2 shows an overview of the city. Some of the smart city features are already depicted in this figure, such as the district heating facilities and the Ökopark which will be explained later on.

Figure 2 - The urban region Hartberg [source: Blue Globe Report #2/2012]

One fact that shows the high environmental consciousness of Hartberg is that the city is part of the movement Città Slow since 2009. Città Slow derives from the ideology slow food for better life quality. Citta Slow has the background that in the current society there is a lot of stress and everything needs to be quick which leads to an unhealthy society and unsustainable lifestyles. Città Slow therefore tries to achieve a certain consciousness about healthiness and sustainability via "decelerating life". This lifestyle is represented by attributes like eating healthy, being conscious about the environment and enjoying cultural facilities like theatres. All of this might sound a little vague and undefined but a city which wants to be official part of Città Slow needs to meet a list of defined criteria such as carrying out recycling projects.

Another pro-environmental part of Hartberg is its membership in the "Klimabündnis Österreich" (climate alliance Austria) since 1992. This movement aims to reduce greenhouse gas and particulate matter emissions, increasing energy efficiency and enforcing sustainable energy supply. While the Città Slow movement rather represents the attitude of the residents, the climate alliance already led to some crucial measurements in the past for example:

- Subsidies of solar thermal and biomass small scale heating systems,
- Establishing the Ökopark Hartberg - this is an area that accommodates companies specialised in the environmental/energy sector, research centres and leisure facilities; thus it combines economy with research and ecology and is considered as a pilot project in Europe, (Ökopark Hartberg, 2015)
- Establishing 11 km of bicycle paths,
- Enforcing energy use of renewable energy sources,
- Using LEDs for public lighting.

These facts built the basis for Hartberg becoming a Smart City. In the following part the smart city features and measurements are listed and explained.

2.2.2 Smart City features already done

In Hartberg there are already a lot of projects done that indicate its status of a smart city. This part deals with these measurements.

The Stadtwerke Hartberg (public utility company Hartberg) with its headquarter at the already mentioned Ökopark is one of the main contributors for the sustainable energy supply of the urban area Hartberg. The company runs exclusively renewable energy systems.

The public utility company Hartberg is the regional market leader in photovoltaic with 1 000 installed photovoltaic (PV) systems. The company began its encouragement in the PV sector already twenty years ago with a program called the 200-roof program. What's more the company runs a wind park consisting of thirteen wind turbines which are installed in a close village called Parndorf. Moreover the Stadtwerke Hartberg runs two biogas systems. The waste heat of the biogas systems is converted into electricity by a Stirling engine. The Stirling engine is a research project together with Joanneum Research. (Stadtwerke Hartberg)

Not only is the renewable share of the electricity demand quite high, but also the share of sustainable energy carriers in terms of final heating energy demand is significant. In the urban area of Hartberg there is a biomass based district heating system with a rated power of 18 MW that delivers 32 GWh of heat energy per year. (Blue Globe Report #2/2012, 2012) Figure 3 shows the shares of the energy carriers for the heating demand in Hartberg.

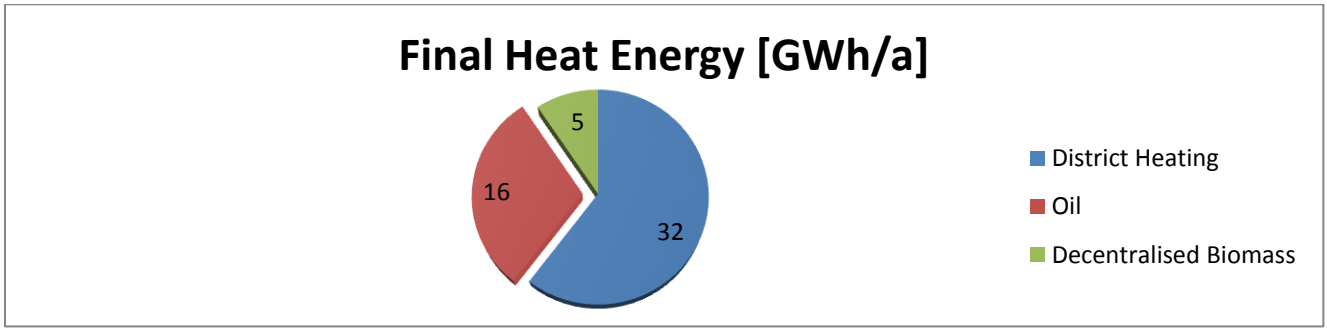

Figure 3 - Final Heating Energy Hartberg [source: Blue Globe Report #2/2012]

The district heating system accumulated with decentral biomass heating systems leads to a share of roughly 70 % of renewable in the heating sector.

Along with electrical energy and heating energy the transport sector is the third main sector that consumes final energy. Considering mobility, Hartberg offers two innovative public transport systems which are car sharing and a city bus.

At the border of the Ökopark Hartberg there is a photovoltaic charging system for a car sharing-car equipped with electrical drive called "Harti" (Klima - und Energiefonds, 2013). Furthermore the smart region cooperates closely with the private car sharing platform "car sharing 24/7". This internet platform offers private persons to share their cars in order to reduce their fix costs of the car. Other people who need a car can contact a car owner via car

sharing 24/7. Thus everyone has access to a car and the effect on the environment can be lowered because on the long run the number of private automobiles decreases.

Hartberg also operates a city bus. This city bus is free to use for 10 years now. A recent improvement is an information system connected to the city bus. Via an app every smart phone user can check the current position of the bus. This shortens waiting periods and statistically increases the number of people using the city bus.

Since Smart Cities are not only a matter of energy and sustainability there are also other aspects to consider. For example a smart layout of public places leads to a more friendly city appearance and thus to a better life quality. Including Shared Spaces is one way to enrich a city's public appearance. This means getting rid of the old fashioned pattern pavement - street - pavement and implementing a common area for pedestrians, bikers and cars. Shared Spaces also provoke car drivers to be more careful and attentive since there is no border that separates the street from the pavement. Examples for Shared Spaces in Hartberg are the Kirchengasse, the Wiener Straße and the Alleegasse.

One general strategy that the town's council uses for turning the region Hartberg into a smart one is enforcing subsidies for renewable technologies. For example if a person wants to install a biomass heating system in his or her house there are a lot of subsidies to benefit from. The Klima - und Energiefonds pays 2 000 € of subsidy. The city Hartberg contributes 1 500 € and the state Styria 1 400 €. Adding the 100 € voucher from the local "Lagerhaus" (hardware store) a decentralised biomass heating system is subsidised with 5 000 €.

Finally when it comes to already installed innovative technologies Hartberg also has a solar cooling system and an absorption chiller. (Blue Globe Report #2/2012, 2012) Along with the already mentioned Stirling engine there is a significant number of innovative technologies supported by the Smart Region Hartberg. This is an important contribution to research and development which is also an essential aspect of a Smart City.

2.2.3 Smart City features to come

In order to become a Smart City a detailed roadmap until 2020 was developed throughout the project "Città Slow Hartberg meets Smart City". The goal of all the measurements accumulated is to save 73.2 GWh/y of primary energy. This equals a reduction by 21 %. This leads to a CO_2 emission reduction by 27 300 tCO_2/y which equals a percentage of 32 %. (Blue Globe Report #2/2012, 2012) Some of the measurements already have been completed like the using LEDs for public lighting, establishing subsidies for renewable energy technologies and establish shared spaces. Further measurements are listed below:

- Extend the bike lanes to 27 km total length
- Subsidising of grey-water recovering; grey-water or sullage means all the waste waster accumulated except for toilet waste water; sullage is less contaminated and contains fewer pathogens and therefore is easier to recycle, (Greywater Action, 2015)

- Subsidising of alternative transport technologies of individual traffic (e-mobility, bio fuels)
- Active Demand Side Management in order to harmonize the load curves of electricity
- Active Demand Side Management in order to harmonize the load curves of district heating

In general it is notable that the urban region Hartberg directly involves their residents a lot. The town's council is enforcing questionnaires for ideas and wishes of the people living in Hartberg when it comes to Smart City and environmental projects, often using the internet. For example there have been questionnaires concerning plans and wishes for "Hartberg 2020" and "Hartberg 2050". What's more the measurements are always connected with information campaigns on renewable energy technologies, car sharing and Smart Cities in general. According to the survey (Suschek-Berger, 2014) this involvement leads to a result that climate and environmental protection is important to 86.4% of the residents.

3 Comparison the Czech Republic/ Austria/ EU 28

The sections one and two represent the theoretical part of the work. This section represents the practical part. In order to compare the projects, several criteria have been chosen in which the particular representative projects will be compared. The chosen criteria are listed in the following table.

Table 1 – Comparison of the Smart Region Vrchlabí and the Region Hartberg

#	Criteria for comparison	Vrchlabí	Hartberg
1	Number of residents	13 000	12 500
2	Elevation	477 m	359 m
3	Bus and train connection	yes	yes
4	Project initiation	electricity producer ČEZ, a. s.	town's council
5	Extent of smart region	town Vrchlabí	town Hartberg, Hartberg surroundings, St. Johann, Greinbach
6	Motivation for establishing a smart region	Testing the various technologies to cooperate together	"Slow food for better life" as a part of Città Slow - healthy lifestyle
7	Pro-environmental membership	Location on the boundary of the Giant Mountains National Park	Klimabündnis Österreich
8	Recycling projects	yes	yes
9	Bicycle paths	2,5 km	11 km
10	Planning extension of bicycle paths	no	yes - up to 27 km
11	Bicycle paths as a part of the smart region realization	no	yes
12	Shared spaces	none	Kirchengasse, Wiener Straße, Alleegasse
13	Renewables	5 photovoltaic systems - rating power of 86 kVA 2 small hydro power plants - rating power of 350 kVA	1 000 installed photovoltaic systems wind park with 13 wind turbines solar cooling system
14	Innovative public transport	3 distribution stations for electric cars the Peugeot iOn electric car for the use of town leaders	car sharing - 24/7 internet platform photovolatis charging systém for car sharing city bus for free, app to check the current position

15	Changes in technology within the smart region	unification of the voltage to 35 kV implementing optical cables and other communication equipment replacement of several distribution transformer stations 4900 installed electro meters island operation for the local housing estate, the biggest elementary school (1000 students), the local gymnasium (360 students)	LEDs for public lighting
16	Heating system	two of three cogeneration units with a rated thermal power of 2,611 MW	district heating system based on biomass with 18 MW of rated power
17	Questionnaire for awareness about the realization of the smart region project	yes	yes
18	Questionnaire for ideas and wishes of residents	no	Hartberg 2020 Hartberg 2050
19	Interests of residents	mainly no	mainly yes
20	Primary energy demand reduction by 2020	no data available	73.2 GWh/y (21 %)
21	CO2 reduction by 2020	no data abailable	27 300 tCO_2/y (32 %)

The general result of the comparison is that the projects diverge from one another in several aspects. Main differences are seen in the table above, where they are highlighted. Apart from the similar size and less significant factors like the altitude the smart regions are quite different. One of the main findings is that the idea of smart cities itself is quite different in these two countries. The smart city idea in Austria is in general broader than the one in the Czech Republic. In Austria the idea not only includes technological aspects but also social aspects like eliminating barriers to make places more suitable for handicapped people. Furthermore the concept contains affordable living and an environmental conscious lifestyle. In the Czech Republic the focus is very technical and comprises the implementation of sustainable and more efficient technologies.

In the Czech Republic there is only one project that is implemented and it is a pilot project for the whole country. It is realized by the private electricity producer ČEZ, a. s. for a purpose to test as many new smart technologies as possible to work and cooperate at the same time together. It is the only reason why the pilot project has been set off.

In Austria there is a webpage www.smartcities.at, where it is possible to obtain any kind of information about all of the smart region projects. Because of the fact that the project is very young in the Czech Republic, there is a very small amount of available information. The important data are top secret so far, because the project is still in the testing phase. Even the provision of information in Austria is more developed. From the table above, it can be seen that the Czech project is – like already mentioned – only about the technology. There are aspects like island operation, charging stations for electric cars, unification to 35 kV, and the replacement of the distribution stations. The company has a clear goal to make the technologies work together and the opinion of the residents is not an influence.

On the contrary in Austria the smart initiative has an impact on a lot more things. It influences the architecture of the region (e.g. shared places) and the attitude of the people (healthy lifestyle, pro environmental thinking of the residents). A possible reason for this might be the active involvement of the people via questionnaires.

In the Czech Republic the reduction of CO2 emissions is only a pleasant bonus for the effort to create a smart region. Until the date of publication of this work no measurement has been taken. A survey of the bachelor thesis (Rychterová, 2014) leads to the results that 83 % of the respondents did not know or understand what the topic of the Smart Region Vrchlabí is all about. In Hartberg a high provision of information is achieved by questionnaires like "Hartberg 2020" and "Hartberg 2050". This leads the result that 86.4 % of the residents care about climate and environmental protection and to a high awareness about the topic in general.

Several smart city projects exist in Europe. It is notable that there are various different approaches to the topic. In Italy for example, the roll out of smart meters has been the first step initiated in 2006. Concluding from the findings, the European smart city projects are rather different making every project very individual. Big impacts on smart city aspects are the concept of smart cities in the country itself, the current state of development of smart technologies, the juridical background and the attitude of the government, town councils and the population. Therefore it is only possible to get different inspirations and approaches but the projects cannot be copied.

To sum up, the conclusion is that in Austria the smart regions are further developed than in the Czech Republic. For now, the Smart Region Vrchlabí is the only smart city project in the country. In the future it will be important for the Czech Republic that the perception of the term *smart city* evolves to the same standard as in Austria in order to guarantee a sustainable future.

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