

Korneuburg's way2smart – Mobility Concept, Energy Platform and Social Interaction

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1 ABSTRACT

This paper aims to present the methods employed by the demonstration project “Korneuburg Way2Smart” to contribute to the municipality’s plan of achieving energy self-sufficiency by 2036. The municipality of Korneuburg plans to refurbish two municipality-owned residential buildings. This includes the compaction of two buildings by way of super structures and annexes, as well as utilization of facade and roof areas for energy-generation. In an attempt to answer the questions arising in a general public along the way to a broader acceptance of this smart city vision, an online energy platform with interactive maps is employed to visualize the current energy situation city-wide, and highlight the future potential of renewable energy sources and refurbishment measures for individual buildings. The energy platform aims to support residents and stakeholders with energy forecasts according to different development scenarios to underpin energy and building decisions and for them to achieve their goal of energy self-sufficiency. The implementation of the web platform’s user interface must meet several requirements: It is required to be both intuitive and easy-to-use by non-professionals. In addition, it must be able to cover a wide range of use cases such as input of building energy calculation parameters and energy scenario parameters, as well as various measurement data. The inclusion of citizens and neighbourhoods in the transition process is another focus of the project. Residents are informed about the municipality’s actions from an early stage and can partake in decision processes. With the so-called “buddy-program”, the education of a wider public on technical topics, possibilities for self-organisation, management of car sharing, etc. are also part of the project. New and innovative mobility concepts such as “tenants-mobility” are also explored. The buildings of the project are planned as “nearly car-free” buildings.

Keywords: nearly car-free, databases, energy platform, Korneuburg, simulation

2 INTRODUCTION TO THE PROJECT: WAY2SMART KORNEUBURG

Cities in Austria are constantly evolving and need to reinvent themselves continuously, especially due to impending changing climate, increasing scarcity resources and urbanization. A small town, Korneuburg near Vienna, with about 12,000 inhabitants, gets ready to meet these challenges. Until 2036, the forecasts predict a population increase in Korneuburg of up to 50%. To meet the needs of a growing city, citizens, politicians and administration planned Korneuburg's path to 2036 with ambitious objectives in terms of energy and CO2-saving and concentration on “social togetherness”:

The Masterplan 2036 (17&4 Organisationsberatung GmbH et. al 2014), Korneuburg’s urban development concept, created with a big public participation-project in the year 2011, is based upon three pillars: social interaction, education and water. Public participation and energy-self-sufficiency are the foundation, on which these pillars are built. The Project Way2smart aims to demonstrate how energy-self-sufficiency and high quality of life is affordable also for small budgets.

The three-year project is funded by the Austrian Climate and Energy Fund, with a consortium of researchers, grid operators, energy planners, mobility planners and architects, as well as the municipality of Korneuburg. The specific goals of the project are the refurbishment of two municipality-owned residential buildings and the creation of a mobility hub in the area of the rehabilitated objects and thus create alternatives to the use of private cars. In this prototype housing scheme, affordable small apartments are to be provided to young tenants in a targeted manner. Figure 1 shows the two municipality-owned residential buildings that the

municipality of Korneuburg intends to rehabilitate, with the intention to live up to its 2036 Vision Statement and Master Plan.



Figure 1: The two municipality-owned residential buildings to be rehabilitate (HuB architekten ZT KG 2013)

As accompanying measures, (i) communications programmes are to reconcile measures and needs of existing and new tenants on a level-playing field with experts. The main goal here is to achieve acceptance for rehabilitation measures as well as self-organisation. (ii) Tenants and other citizens will be informed of and mobilised for the objective of the energy-self-sufficiency of Korneuburg. (iii) Property developers are involved in the process which is monitored by sociologists. An energy platform should support the involvement of the citizen in the transformation process.

3 ENERGY PLATFORM

The purpose of the proposed energy platform is (i) to provide examples of best-practice buildings, (ii) to visualize the status-quo of Korneuburg's energy situation, (iii) to highlight energy potentials and (iv) to accumulate detailed building data through input of measurement and audit results.

Purpose (i)-(iii) aims to guide residents and stakeholders of Korneuburg municipality to achieve their goal of energy-self-sufficiency. The accumulation of building data (purpose iv) supports that by gradually improving the underlying data, thus strengthening both accuracy and validity of the proposed measures and scenarios.

Implementation: The implementation of such a platform requires three key components: First, a means to store the various data of each subject matter in a consistent and useful form. Second, a way of determining the energy status and potential of the whole city. Last, an accessible interface for residents and other stakeholders to access this information and provide additional data.

3.1 Energy Database

The first requirement is met by a database that stores all relevant information. This energy database collects building energy information in the forms of energy performance calculation and literature for best practice examples, measurement and bill data, as well as simulation results.

The data comes from different sources: Participating residents and key stakeholder can provide measurement data, utility bills and energy performance certificates to better qualify existing buildings. Best practice examples and potential measures are derived from previous research and literature. A designated simulation engine provides results for energy scenarios, both on the level of a single building, as well as the whole municipality.

Table 1 shows data types A – D being used concurrently and combined for purposes i) through iv). The challenge is to relate these different data types to use them for both information and simulation purposes.

Data type	Accuracy	Purposes			
		(i)	(ii)	(iii)	(iv)
A - Simulation result	low	(m)	(m)	(m)	
B - Energy performance certificates	medium	(*r)	(*r)		(in)
C - Utility bills	high	(*r)	(m)	(m)	(in)
D - High-res measurement	Very high	(*r)	(*r)		(in)

Table 1 Data types for information and simulation purposes

Purposes: (i) Best Practice, (ii) Status-Quo, (iii) Potentials, (iv) Data accumulation, (m) Matlab simulation engine, (*r) data from reference projects and project tasks, (in) web platform user (in)put

Key aspects:

- Data sources: Residents, Stakeholder, Researchers
- Data types: Measurements, energy performance certificates, utility bills, simulation results
- Data security & privacy: User inputs must be secured, and anonymised if displayed for a general audience
- Data appreciation: With time, low quality data and underlying estimates can be gradually replaced by higher quality data through the web application interface described below.

3.2 Simulation engine

The purpose of the simulation engine is twofold: First, calculate the energy balance for individual buildings with detailed input data and high resolution. Second, provide grand-scale simulation capabilities for energy scenarios of Korneuburg, taking into account different refurbishment standards and rates, as well as different time frames. Both features can use building data from the energy database as input.

The grand-scale simulation groups individual buildings together according to their energetic characteristics. Each group is represented by an automatically created building model using predefined components according to the group's characteristics (e.g. '60ies detached single family house'). These virtual building models contain properties of geometry, usage characteristics and thermal properties which are predefined according to typical Austrian conditions.¹

This approach entails additional synergies: The grand-scale simulation benefits from detailed resident input to refine the assumptions from the 'typical buildings' model by adding measurement data on top of it.

3.2.1 Simulation method

The method is based on tools from two pre-projects. The first tool was conceived by master students of the University of Applied Sciences Technikum Wien (Galosi et. al 2012) and performs static simulations of the energy balance of Korneuburg. The user inputs are building data regarding geometry, construction method and energy systems. This approach was tested and validated with results from existing energy registers of Korneuburg (2008). For this project, input handling was generalized to include prebuilt libraries of building components, energy systems and default standards, which group typical building components and energy systems for a given building period, construction method, geometry type and usage.

The second tool originated from two research project conducted by the Austrian Institute of Building and Ecology (IBO). It provides dynamic calculation methods for thermic building simulation in a single thermal zone and yields energy usage, energy supply, humidity and temperatures in a quarter-hour resolution, as well as CO₂- and primary energy balances. The tool was validated using a TRNSYS reference model and provides a basis for the simulation engine of the energy platform (Rondoni, et.al. 2015).

As a combination of these two tools, the simulation engine can deliver detailed dynamic energy simulation results on any particular building, be it with detailed user input or using the existing building libraries shown in in Table 2.

For the purposes of grand-scale scenario calculation, the engine performs two separate steps: First, calculate the detailed energy performance of all defined building types/models. Then, aggregate the results according to the spatiotemporal occurrence of these buildings throughout the scenario to obtain a city estimate.

For simulation purposes, any building – virtual or real – requires an orientation associated to its geometry for weather and insolation effects to be applied correctly. Therefore, the simulation of real city quarters needs to take the effects of orientation into account when appending the same virtual building for every real building of similar type but different orientation.

Korneuburg is located on the river Danube, which runs from the North-West to South-East, and the roads network matches that cardinal direction. Since most buildings are in line with their street direction, the

¹ Episcopo: Regional Case Studies (RCS) Austria, 2015

overall distribution of the city favours South-East and South-West orientations. To accommodate for this effect, building and street orientations from GIS data are analysed and matched with the overall built area. The result is a distribution of building quantities and areas for each orientation.

Construction method	Building Standard	Geometry	Type of usage
Reinforced concrete	1900	Single family house	Home
Brick	1920	Apartment building	Commerce
Solid wood	1950	Business	Office
Lightweight	1960	Industry	Business
Mixed	1970	Commerce	Industry
	1980	Office	Kindergarten
	1990	Miscellaneous single-storey	
	Renovated conventional	Miscellaneous multistorey	
	Renovated –low-energy-building		
	Renovated –passive house		

Table 2 Properties of geometry, usage characteristics and thermal properties

In the second step of the grand-scale simulation, the virtual typical buildings in their distinct orientations are scaled by the total floor area occupied by the respective building type. The distribution of building types can also be time- dependent with a transition function. This so called 'refurbishment rate' reflects gradual transitions of one type to another through refurbishment and densification.

3.2.2 Data for building description

Buildings can include solar active components. The performance of such systems (i.e. Photovoltaic, hybrid and solar thermic collectors) depend heavily on their orientation. For this reason, they cannot be included in a generic building type geometry, because types have no defined orientation.

Instead, the simulation applies an allocation function to obtain optimal solar active component configuration as a function of building orientation and building geometry.

The allocation algorithm is a function of orientation and area of the building's surfaces. The allocation is optimized for cost-efficiency of the components but any optimization criteria are possible.

3.3 Web application

The web application is devised to facilitate the following use cases:

- (i) Users can provide additional data of their own house to improve the database and obtain more accurate results for themselves.
- (ii) Users can browse best practice examples and compare them with their current building.
- (iii) Users can analyse the effects of suggested refurbishment measures on their own house and the city in total.

Key aspects of this platform are:

- Provide Project identity constituencies and motivate participants as opposed to mere supply of information
- Social inclusion: design for accessibility.
- Focus on Gender & Diversity principles for web applications
- Data visualization: The main part of the web application is an interactive 2D/3D map of Korneuburg
- Data integrity: The interface must ensure that data provided meets the database requirements
- Data validity: Syntactically correct but (semantically) wrong data pose a threat.

4 MOBILITY-CONCEPT

Korneuburg is a small, but growing city. Plus nearly 50 % inhabitants until 2036 is also a big challenge for mobility. Business as usual would lead to daily traffic jams, a loss of life-quality. And not at least to environmental impact: individual motorised transport is responsible for about one third of greenhouse gas emissions.

There are 1,3 cars / household in Korneuburg (Rosinak und Parter 2015) – and people use their car for more than 50 % of their daily ways. Urban mobility, that offers a mix of transport-modes for all daily ways of the inhabitants, is necessary, to get people independent of the possession of an own car.

Public transport is a part of the solution. Korneuburg's connection via train to Vienna and Stockerau is rather good (5 trains per hour), but the connection to the surrounding region per bus is insufficient. Although in Austria the provinces are responsible for public transport offers – Korneuburg plans to increase its quality and make public transport more visible in the town. Bus stations will be changed to “multi-modal-mobility-points” – the first one will be settled at the bus station in front of the way2smart building.

4.1 Offers for tenants-mobility

The way2smart building is planned as a “nearly car-free building”. The demonstration-project includes different options to make alternatives to the “own car” more attractive.

- bike stands: easy to reach for the tenants, theft-proof, in a sufficient amount (1 bike per person)
- e-car sharing
- e-bike and/or cargo-bike sharing
- optional screen-display of the mobility-point also inside the building

Korneuburg's building code requires to build 1 ½ parking spaces for each new flat. This regulation will not be changed for the way2smart, but will be political discussed after evaluating the mobility-project-results. It was a big challenge to find ways to fulfil the requirements of the building code, especially because “small flats for low costs and high energy-efficiency” is a main part of the way2smart demonstration project. 27 underground-parking-spaces are planned, but that is not enough for 25 new flats. So, it is necessary also to reserve surface parking-space at the building site and in the near surrounding.

In 2015 Korneuburg conducted a mobility survey (in preparation to a mobility-concept). The results: an average household in Korneuburg owns 1,3 cars and 2,6 bikes, 11% of the household do not own a car (32 % own more than one car).

The tenants and people interested to become tenant of the way2smart project where also asked for their mobility-behaviour. The results: 0,75 cars and 1,3 bikes per household and 47 % of the households do not own a car (only 19 % own more than one car).

So, it is visible, that tenants of community housing show a different mobility behaviour, that also might be taken into consideration.

4.2 Awareness and education

Social interaction and communication is also an important part of the mobility-concept of way2smart. The buddy-program of way to smart (see chapter “social interaction”) also includes information about mobility and the costs of an own car versus multi-modal mobility.

There are many other reasons for alternative mobility, like environmental impact, quality of live and prevention of traffic-jams, that also will be part of the buddy-program. The most important fact for the target-group of community housing tenants will be, that multi modal mobility is cheaper than using the own car.

5 SOCIAL INTERACTION AND COMMUNICATION

It's not only the technical equipment, that makes living smart. Social interaction and communication play a key role in our project. The residential building with up to 50 flats is also meant to be a model for best practice housing community.

It's a small town's advantage, that neighbours know each other, learn to respect each other and finally help each other. Especially if the monetary income is not too high (there are income-limits for getting a community housing in Korneuburg), the value of a good neighbourhood should not be underestimated.

5.1 The “buddy-program” – tenants information at eye-level

The way2smart includes also a so called „buddy-program“ for information and education on topics like the correct use of the technical equipment, possibilities for self-organisation (person of trust as representing the tenants, management of car-sharing and common rooms, and so on). At eye-level is important for the acceptance of the “teacher” and the content, that shall be transmitted. That is why speakers and teachers will come from relief organisations as well as „ordinary citizens“ from Korneuburg, sharing their special knowledge. It's easier to accept or believe, to discuss and finally be inspired from a message, if it is delivered from someone, you can identify with.

The way2smart includes a special offer for young people searching for their first own housing. „Starter-flats“ can be hired for a limited time (3 years) for a lower rent. The first step to independence and a possibility to find out, what is important for the own lifestyle. The buddy-program reaches it's goal, when „the starters“ are inspired by the lifestyle of way2smart and carry their experience to their next housing community

On the one hand, users training is important to gain the full efficiency of the technical equipment. If tenants understand the technical background of users-instructions it's easier to act accordingly. On the other hand neighbourhood-assistance helps saving money, strengthens the self-confidence and supports cooperation, respect and good relation between tenants.

5.2 Early communication with neighbours and tenants

Communication with tenants and neighbours will take place as early as possible, at a time, when the extensions and plans of the building are not fixed. So the wishes and worries of tenants and neighbours can be taken in consideration, if they are useful and sustainable.

Korneuburg is a small town with limited construction area and a high population growth. Building densification and its (non-)acceptance in public and particularly in the neighbourhood plays an important role in the Masterplan2036. Many construction-projects of the last years led to controversies with the neighbours, some of them were temporarily stopped by the protests. The solution for this problem provided in the Masterplan is earlier and better communication between building owners and affected citizens.

The first information-session for former tenants took place in spring 2016. About 40 tenants and interested people got an overview of the planned building and smart-city measures and provided input and experiences, that will be taken into account for the further plans.

Due to delays of the construction-schedule information-sessions and workshops will be continued in June 2017, when planning, pricing and construction completion are more detailed. Especially young people will not wait 2 years if they decide to start their own lives in their own flat. Further information-sessions will be held periodical and allow cross-entry for new interested people.

Preparatory a survey on the tenants and people interested in a community housing flat was started, to get information about the wishes of former tenants. The results are in accordance with the previous planning: people want small and cheap flats and some of them are interested in alternative forms of housing like flat-sharing and assisted living. Also a different mobility-behaviour became visible (see chapter mobility) – way2smart-interested people own a lower number of cars in their households than the population average.

Also the first information-session for neighbours took place in spring 2016, but only few accepted the invitation. So it is intended to repeat this first session in June 2017 and create the invitation in a more “populist” style.

5.3 Property developers' workshops

How to motivate property developers to build smart?

Experiences made in the realisation of the construction project, the mobility measures and the participation-process will be shared and discussed in property developer's workshops. Possibilities for local councils promotion and support of smart-city measures in further construction projects will be the result of these workshops.

6 CONCLUSIONS

This paper provides a deeper insight into the project developments of “Korneuburg’s Way2Smart”. It summarizes the current status-quo of the project with already accomplished milestones, including the energy platform, the mobility concepts and social interaction and communication.

The Energy Platform has the goal to support the residents and stakeholders of Korneuburg’s municipality to achieve their goal of energy- self- sufficiency. Big challenge is the implementation of user interface must be both intuitive and easy-to-use by non-professionals while being able to cover a large number of use cases such as input of building energy calculation parameters, energy scenario parameters, input of various measurement data, et cetera. At this point, especially input processing and validation remains as a big concern in the future. The inclusion of the tenants and the neighbours in this changing process is a main point in this project. So the citizen, tenants and neighbours are informant about the actions from the early stage. With the so-called “buddy-program” the education on technical topics, possibilities for self-organisation, management of car sharing, etc. is part of the project. Also the mobility concept is looking for new innovative ideas, like tenants-mobility. The buildings of the project are planned as a “nearly car-free building”.

7 ACKNOWLEDGEMENTS

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