



Figure 1. The first neZEH selected showcase: the Boutiquehotel Stadthalle in Vienna.

An existing best practice of nearly Zero Energy Hotel



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The paper presents the design concept and the energy consumptions of one of the few nearly zero energy city hotels in Europe, the Boutiquehotel Stadthalle in Vienna. The provided information resulted from meetings and questionnaires to the hotel, which was interviewed as best practice in the neZEH project.

Keywords: neZEH, nZEB, hotel, refurbishment project, sustainable design.

Showcasing existing best practices of nearly Zero Energy Hotels is one of the activities undertaken by REHVA as a partner of the IEE founded project neZEH*. Aim of this task is to provide hoteliers with the direct evidence that the

* **Nearly Zero Energy Hotels (neZEH)** is a 3-years long project supported by the Intelligent Energy Europe (IEE) program started in April 2013, involving a consortium of 7 European Countries (Croatia, France, Greece, Italy, Romania, Spain, Sweden) and 10 partners. The project aims at accelerating the refurbishment rate of existing buildings into nZEB in the hospitality sector and promoting the front runners. Focusing particularly on the SME hotels. <http://www.nezeh.eu/>

nearly zero energy level is an achievable and profitable target for hotels.

To show to potential pilot project's initiators a complete overview of the best practices refurbishment process, information concerning both the economic and technical features are asked to the showcases, structured as a questionnaire for the technical and quantitative questions and as an interview for economical and qualitative aspects.

The first hotel selected as a showcase was the Boutiquehotel Stadthalle in Vienna (**Figure 1**) and the derived information are reported in the following paper. In this hotel the nZEB level is reached in the newly built "passive building", which became the world's first example of nearly zero energy city hotel.

The Hotel

Boutiquehotel Stadthalle is a three star hotel in Vienna, which became the first city hotel with a nearly zero energy balance thanks to its manager's strong commitment to environmental issues. The whole structure is formed by an apartment building of the beginning of 19th century and a newly built passive building. The hotel renovation process began in 2001, when Michaela Reitterer, current owner and manager, bought the 19th century hotel building and started to refurbish it. To comply with Ms Reitterer higher goals, in 2009, new works started to couple the renovated existing building with the new passive house, a nearly zero energy building, which was completed by the

beginning of 2010. The additional building's installed technologies allowed it to reach a nearly zero energy balance.

The hotel has 79 guestrooms in total, 41 in the old building and 38 in the passive house, and does not offer extra facilities apart from a lounge bar. In accordance with what was defined as "typical energy use of a hotel" in the neZEH project, the latter aspect allows to consider all the energy consumptions of the Boutiquehotel Stadthalle in the nearly zero energy balance.

Table 1 displays the main data about the hotel.

The energy system

Different energy systems are installed in the "old" building and the passive house. While the refurbished 19th century building mainly uses district heating and has no cooling and active ventilation systems, the new section is equipped with a groundwater heat pump for heating and cooling, used for the concrete core activation, and with controlled air room ventilation (only ventilation, no air conditioning).

An in-house well serves as cooling source and provides groundwater to the heat pump, powered by a 13 kW_{peak} photovoltaic system (93 m²). In addition, 130 m² of solar thermal panels are used to produce domestic hot water for the whole hotel, as well as to pre-heat the fresh air through the ventilation system, which achieves over 90% heat recovery, as conceptually schematized in **Figure 2**.

Table 1. Hotel's main information.

Name	Boutiquehotel Stadthalle
Location	Hackengasse 20, Wien
Type of hotel	Urban
Owner	Michaela Reitterer
Floor area	2.271 m ²
Floors	4 (existing building) – 5 (passive house)
Guest rooms area	1.316 m ²
Guest rooms	79 (41 in existing building + 38 in passive house)
Guest beds	156
Offered facilities	Lounge bar
Total refurbishment costs	5.200.000 € approx.
Refurbishment cost	2.290 €/m ² approx.

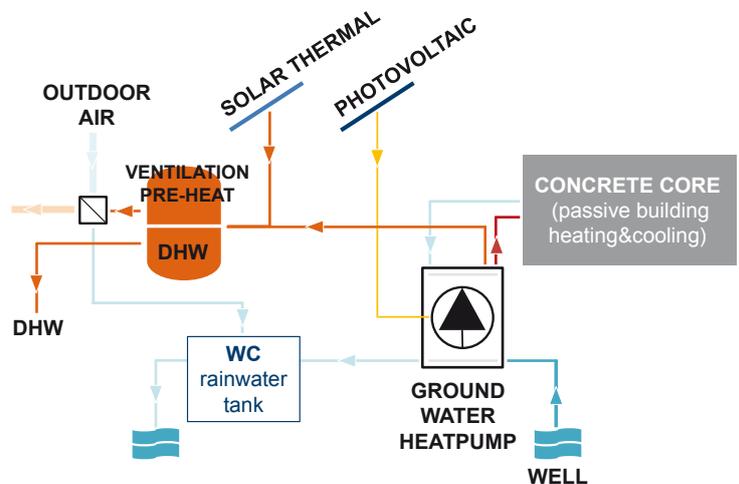


Figure 2. Conceptual scheme of the heating&cooling system and of the domestic hot water production.

The electricity needs for auxiliary systems, appliances and lighting not covered by the PV plant are currently supplied by the electricity grid, but 3 wind turbines are waiting for the permission of authorities for being installed on the building roof.

The hotel energy system is summarized in **Figure 3**.

The building plants are managed by a Building Automation and Control System (BACS): programmable automation controllers help maintaining the right balance between guest comfort and energy savings by monitoring and enabling the regulation of heating and ventilation based on actual demand or pre-defined schedules. The system also controls and monitors the concrete core activation, water heating, the solar panel system, buffer management and the groundwater heat pump.

The energy consumptions

The amount of measured delivered energy in the past three years by the Boutiquehotel Stadthalle is reported in **Table 2**.

To obtain primary energy, the proper primary energy factors are applied to the average yearly heat and electricity consumptions. The European non-renewable primary energy factors set by the latest version of standard FprEN15603:2014 are used: 1.30 for district heating, 2.30 for grid electricity. The obtained primary energy performance for the whole hotel (existing building and passive building) is shown in **Table 3**. The energy factor for the passive building, taking only electricity from the energy grid, is derived by applying a factor taking into account the different dimensions (number of rooms) of the old and the new constructions. With these premises, the calculated primary

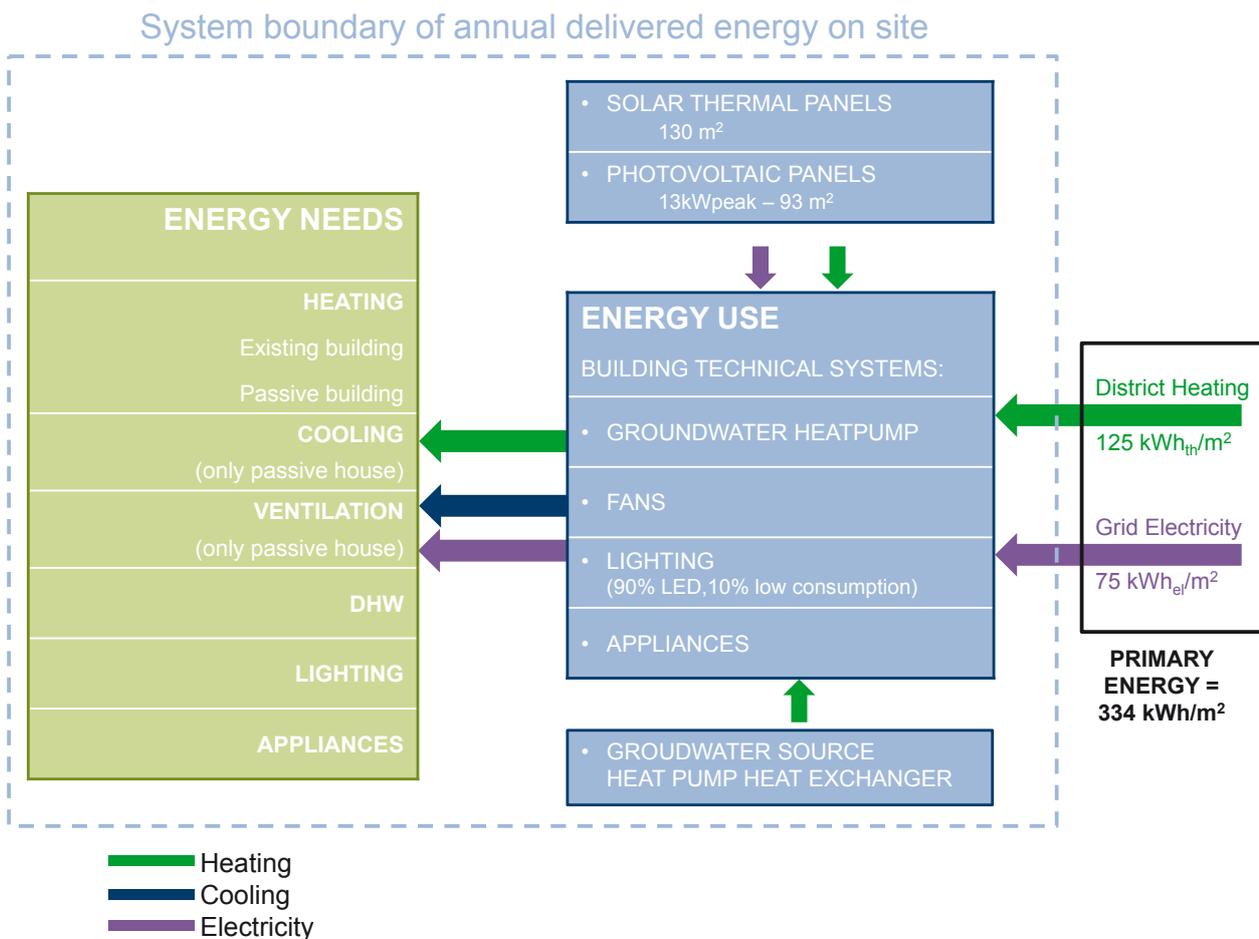


Figure 3. Scheme of the Boutiquehotel Stadthalle energy system.

Table 2. Energy delivered to the building in 2010, 2011, 2012.

Source	Year	Amount of energy use				Type of energy use										
		Total (O*+P**)		O*	P**	Heating		Ventilation		DHW		Lighting		Appliances		
		kWh _{th}	kWh _{el}	%	%	O*	P**	O*	P**	O*	P**	O*	P**	O*	P**	
District heating	2010	301.700		100 approx.	0 approx.	x				x						
	2011	263.100				x				x						
	2012	287.300				x				x						
Electricity grid	2010		170.200	65 approx.	35 approx.		x		x			x	x	x	x	
	2011		159.500				x		x			x	x	x	x	
	2012		177.100				x		x			x	x	x	x	

*O = old building **P = passive building

Table 3. Primary energy factor calculation for Boutiquehotel Stadthalle.

Source	Average yearly consumption		Non-renewable primary energy factor	Primary energy		Primary energy for heating, cooling, domestic hot water, HVAC aux, lighting	
	kWh	kWh/m ²		Whole hotel	Passive building	Whole hotel	Passive building
			–	kWh/m ² y		kWh/m ² y	
District Heating	284.033	125	1.3	163	0	163	
Grid Electricity	168.933	74	2.3	171	124	155	108
			Total	334	124	318	108

energy consumption of the passive building only is approximately 124 kWh/m²y.

The gap in primary energy factors obtained for the whole building and for the passive building only reflects the different level of retrofit actions undertaken. In the passive house, where the goal set from the very beginning of the design phase was the zero-energy balance, the primary energy use including energy uses for heating, cooling, domestic hot water, HVAC aux and lighting, 108 kWh/m²y, is in line with the reference value defined in the context of the neZEH project for Western Europe countries (zone 3 in **Table 4**), presented in REHVA Journal January issue. The primary energy use for the listed energy uses was derived by reducing the total primary energy of the appliances contribution (7 kWh/m² weighted by the primary energy factor).

Other sustainable features

The energy systems of the hotel are only part of the sustainable strategy adopted by the hotel, which strives to contribute to lower the environmental impact of the tourism business by implementing a wide range of measures.

Lighting. In order to reduce the hotel lighting power use, the 90% of the light sources are LED and the remaining 10% are low consumption bulbs. Moreover,

Table 4. Summary of the requirements for nearly zero energy hotels in Europe proposed by neZEH.

Zone	EP [kWh/m ² *y]	Energy uses
Zone 1	55	Heating, cooling, domestic hot water, HVAC aux, lighting
Zone 2	60	
Zone 3	95	
Zone 4	115	

lighting is automatically controlled by sensors in public spaces, while in guest rooms lighting is governed by the room badge presence in the dedicated fold.

Water. Water saving measures were undertaken from the very beginning of the renovation process, in 2001, when cisterns were installed to store rainwater and use it for toilets and the garden. Additional water savings methods were implemented in the new passive building, in which also the cold well-water is used instead of the rainwater to flush toilets.

Food. Despite being breakfast the only meal served at the hotel, the food policy undertaken by the hotel plays an important role in the holistic green vision of the hotel manager: the products served are either local or organic, or both local and organic.

Transport. In the effort of promoting the use of low emissions means of transport, the hotel provides a 10% discount to guests coming by train or bike, a free bicycle garage and free of charge recharge for guests' electric vehicles.

Education. Accordingly with the strong motivation and environmental concerns of the hotel manager, the education of guests is among the main goals pursued. The hotel provides to guests an example of how it is possible to have a zero energy building by informing them directly in their rooms: green points with explanation of the adopted green solutions are placed next to the corresponding point of use. Moreover, to check the indoor environmental quality level in a nZEB, "test sleeping" are arranged for interested parties in the passive house. Beside the education for guests, training courses are organized for staff members.

Waste management. A strict waste prevention (e.g. biodegradable cleaning supplies) and separation policy is implemented in the hotel and recycled fabrics are used in guestrooms.

Certifications. The hotel obtained the EU-Ecolabel certification in 2007, before the construction of the new passive building. Together with a few other hotels in German speaking countries, it is now founder of the Sleep Green Hotels network.

The economical side

Investment. Achieving the nZEB status took a significant financial effort: a reckoning of the investment costs, provided by the hotel manager and owner during the interview, highlighted that the total cost of the intervention from 2008 to 2010 exceeded 5 million euros. The first measures undertaken for achieving energy efficiency in the existing building accounted for more than 1 million euros, while the second part of the project, the passive house, cost approximately 4.2 million euros.

In this case, however, it must be highlighted that the consistent investment is not merely related to the energy retrofit, but also to the additional costs entailed by providing a sustainable and high quality indoor environ-

ment to guests (e.g. factors related to the hotel interior design).

Because of the financial crash of 2008, the extension of the hotel with the construction of the passive house did not receive any finance from Austrian banks except the furniture which was by the Austrian Tourism bank. The renovation was financed through a lease-back scheme according to which the hotel is going to be purchased back by the manager/owner.

Benefits. Despite the considerable risk assumed, the manager's choices were successful. Even if the Return of Investment was not a considered economic index by Ms. Reitterer, whose main purpose was to put in practice her green believes, her commitment proved to be not only a way to reduce the hotel operation costs, but also a choice appreciated by the market. Even if not providing figures, the manager affirmed that the return of investment came back faster than expected. In fact reaching the nZEB status, complementary with the other green actions engaged, entailed on the one side a lot of free visibility and media exposure, and on the other side opened the doors to a completely new target of guests and to a special market sector, enabling the hotel to keep both high room rates and high and constant occupancy rates (average yearly occupancy rate of 82% in 2012).

Conclusions

Achieving the nearly zero energy status in the Boutiquehotel Stadthalle was a result obtained by its manager and owner when the recast of the Energy Performance of Buildings Directive was not even in place. It required strong motivation and consistent economical efforts, very far from the cost-optimal level of energy requirements nowadays suggested by the EBPD recast. Nevertheless it proved to be a successful strategy, both in terms of achieved energy performance and of market appreciation. The Hotel Stadthalle became the first example of nearly zero energy urban hotel, with a primary energy factor of 108 kWh/m²y in the passive building, which is in line with the preliminary benchmarks for hotels primary energy use defined by the neZEH project. ■

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