PV Financing Best Practice: Vienna Technical University – Public Bulding (Austria)

General project Description

The following example describes the biggest building-integrated PV system in Austria. The building concerned, is one section of the Technical University Vienna. It is Austria's biggest plus-energy-office building and the first one worldwide. During a large-scale refurbishment and extension the building was equipped with 2 PV systems. One part of the PV system is installed on top of this 14-storey renovated tower, the other one is integrated into the front of the tower. Here the biggest building-integrated PV system was implemented. The building generates more energy than its operation and utilization consumes. Therefore it is a unique research and construction project.

The PV system is situated on top of the Technical University Vienna, which is located on Getreidemarkt at the heart of Vienna (an urban environment).

Business case description / economic parameters

In the course of the renovation of the Technical University Vienna in 2015, Austria's biggest plus-energy-office building was established. Here also located is Austria's biggest building-integrated PV system. The central point for reaching the plus-energy-standard of the building was the extreme reduction of the energy demand for all sections and components in the building, from heating to cooling and also for the office computers and smaller electric components.
The building originates from the 1970s and offers space for 700 working people. The whole building has a net floor space of 13,000 sqm and 14 floors.

Starting in spring 2012 the building was almost rebuilt within a construction period of 2.5 years. On legal grounds newly constructed buildings must not exceed a certain height. Since this building was constructed according to the old regulations and therefore taller than allowed, it could only be refurbished and renovated for that matter.

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The building's consumption of electric energy amounted up to 2.066,900 kWh prior to its renovation. After its general renovation and its conversion to energy-saving devices the overall energy consumption of the total building (office area and university) could be reduced to 376,319 kWh. The electricity consumption of the office area comes up to 183,323 kWh only.

One part of the PV system is situated on its roof-top, the other one was inserted into the front directly. The PV system on the roof-top has a power output of 97.8 kWp. Showing to the south-east and south-west, the building-integrated PV system, has an output capacity of 230.6 kWp. Covering an area of 1,581 sqm this building-integrated PV system is the biggest building-integrated PV system in Austria. Covering an overall area of 2,199 sqm both PV systems together achieve a power output of 328.4 kWp. The complete PV system generates 248,804 kWh of electrical energy annually.

The modification of the office tower into a plus-energy-office building was supported and promoted by various public authorities via one-time grants (Austrian Research Funding Organisation, Kommunalkredit Public Consulting, City Vienna, Ministry for Innovation- and Technology). According to that the application and processing of subsidies were more elaborate than others with only one funding body.

Approximately 20million € were invested into the entire renovation. The total costs for the PV systems come to 825,000 €. The purchased electricity costs amount to 0.11 € per kWh (including taxes). The current calculations show that the additional costs for a plus-energy building pay themselves off even without subsidies within 10 years.

The aim of the project was to show that with appropriate planning the rebuilding and renovation of an office tower into a plus-energy building is possible. The project proves that the realization of plus-energy-office building is technically as well as economically possible.

Technical project parameters

The project is innovative not only due to the size of the building-integrated PV system, but also due to its cleverly devised technical realisation which rendered the construction of an office tower as a plus-energy building possible. The major challenge of a multi-storey tower with a great amount of electric devices is to implement a PV system on a relatively small

surface area. This is one of the reasons, why parts of the PV system were building-integrated.

Generally during summer the PV system generates more energy than the building consumes. The excess of energy is consumed in the neighbouring buildings of the University complex. During the winter months significantly less PV-electricity is generated, therefore more electricity has to be purchased from the grid. There is no sufficient data available for a conclusive evaluation of an achieveable self-consumption rate yet. The energy consumption was reduced with various means: e.g. waste heat utilisation of the server and energy recuperation/recovery of the lift. By reducing the energy consumption of the existing building to approximately 10 percent, the PV system manages to cover the primary energy demand of the tower. No energy storage devices or smart meters were used in this project.

In order to make optimum use of the rather small surface area, the most suitable PV modules had to be chosen. It turned out that the most important detail is the spacing of cells from the module frame. If it is too small at the lower edge, dirt settlings may cover it, and prevent the system from functioning properly. That’s the reason, why frameless modules were preferred. Additionally the shading of the solar cells could be reduced with cover profiles. For the staircase at the south-eastern front the PV modules were constructed with insulating glass. An important aspect was the rear ventilation of the modules.

In connection with the PV system the fire protection was a challenge, since the authorities required special checks and qualifications. During the planning and preparation process the front integrated PV modules were subject to a fire test. The test proved that the fire does not expand and that large parts would not fall off. In case of a fire the PV system is switched off automatically, since it is coupled to the fire alarm centre.

Both PV systems are sufficiently cleaned by the rain and don’t need any additional maintenance therefore. The installed PV system requires no special supplies or maintenance activities.

A system to optimize and monitor the performance of the modules was installed, which made servicing on the roof top a lot easier. Each module is equipped with a power optimiser.

The ongoing monitoring and evaluation helps the University to gain and analyse new insights.

Stakeholders / companies / PPA

The Bundesimmobiliengesellschaft (short BIG; one of Austria's biggest property owner) is building owner and therefore also owner and operator of the PV system. In turn the Technical University Vienna rents the building but may use the PV generated electricity. The excess power, which is not required in the plus-energy building, is used in neighbouring parts of the University. No electricity is feed into the power grid, therefore invoice as well as feed-in tariff is of no importance.

Like any other construction project the renovation of the office tower included all representative project participants: the Bundesimmobiliengesellschaft m.b.H. was owner as well as builder and the team was supplemented by various specialists from science and research.

The planning and site development had already begun in 2006; its construction started in March 2012 and the building was completed in October 2014.

Replicability / Outlook

Important for the realisation of this project was the financial support of the ministries on the one hand, but also the common desire of all participants (investors, building owner and tenant) to implement this project on the other hand.

An essential obstacle is the fact that a project like that needs an overall and interdisciplinary planning. This involves additional costs. If such a project has to be repeated, a scientific expert should be called in.

The results and insights from the ongoing supervision are essential for further PV projects with multi-storey buildings in the future. Nevertheless this project could easily be implemented for other sectors. It is also possible to realise it in other countries.

A challenge was the fire protection as well as the very limited space available for the installation of a PV system in connection with a relatively large number of storeys.

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Photos

Abbildung 1: Technical University Vienna, Building, source: Gisela Erlacher

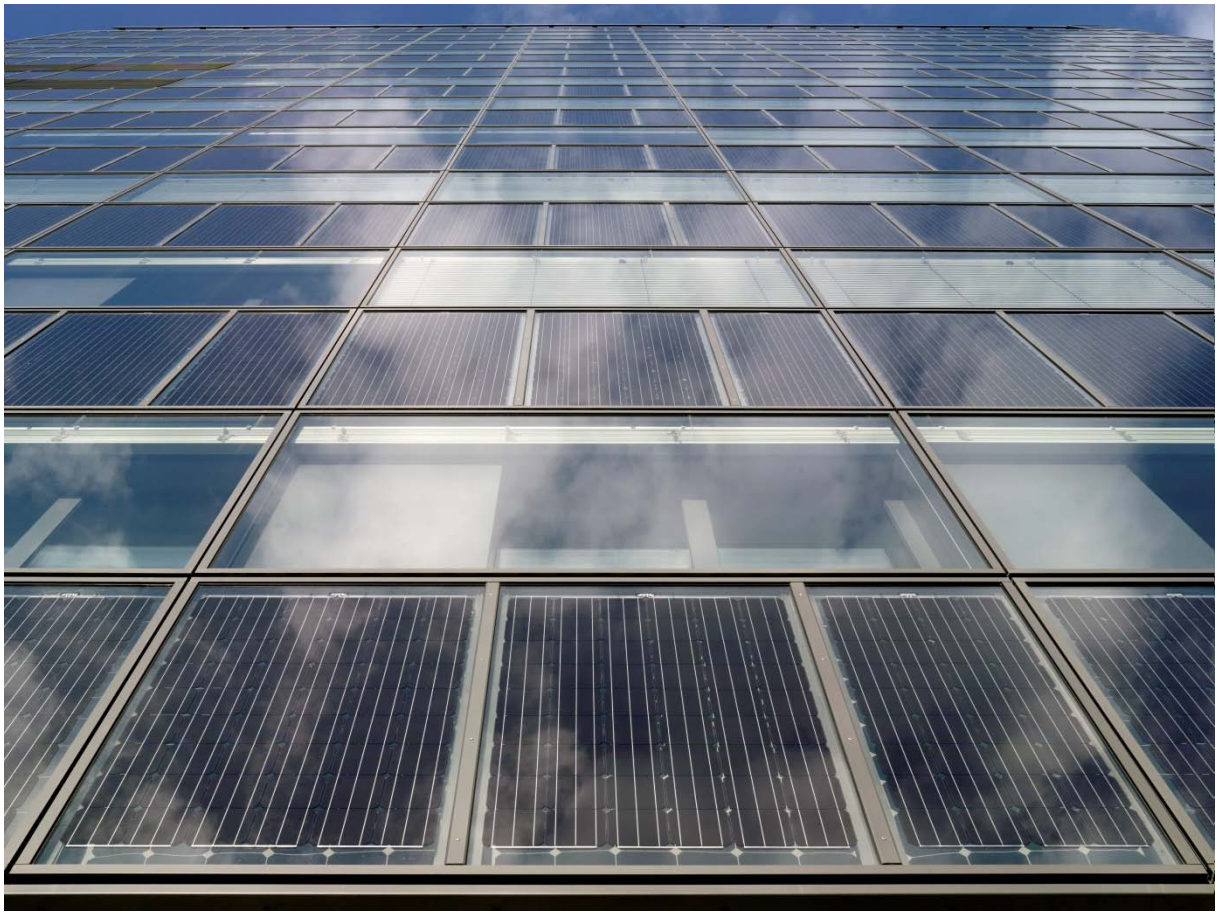

Abbildung 2: Front, building-integrated PV system, source: Gisela Erlacher

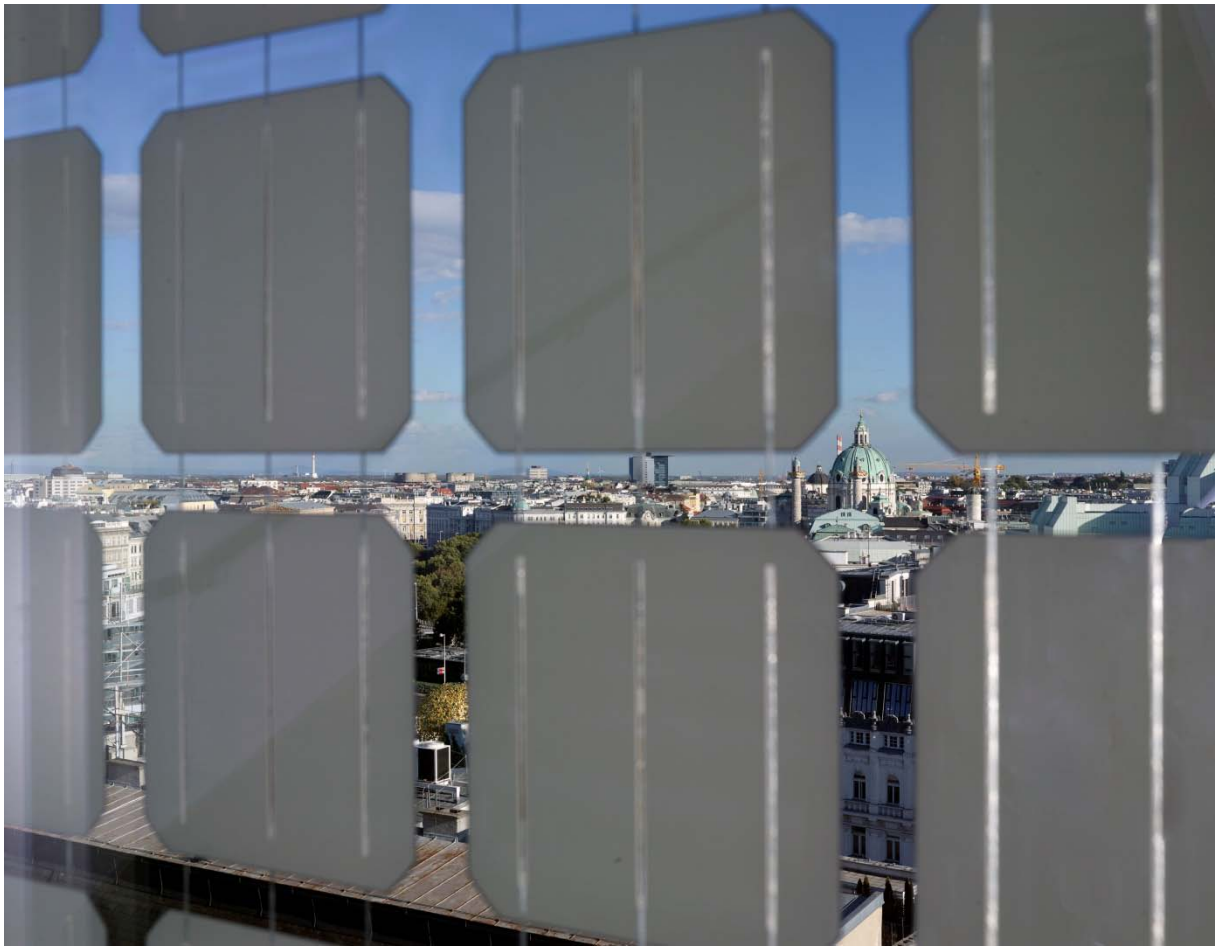

Abbildung 3: PV moduels, source: Gisela Erlacher