PV Financing Best Practice: Wenns Single Family Home (Austria)

General project Description

The following example describes a PV system on top of a single-family household in Western Austria (the Tyrol): Careful considerations and technical refinements made it possible to increase the own consumption of electrical energy up to 95 percent. This accomplishment sets this particular project apart from any others.

The house is located in 6473 Wenns, a rather rural area in the Tyrol. The building includes four flats and an office building. As the whole building is supplied via one metering point, an efficient use of PV generated electricity is possible within the whole complex.

Business case description / economic parameters

Mounted on the roof-top of the building and on ground there are several PV systems, which add up to 20.1 kWp of electrical energy. In total there were three independent PV systems installed:

- In 2006 a PV system with full feed-in and a capacity of 4 kWp was implemented pointing only to the south.
- In 2013 a PV system with a capacity of 14 kWp was added facing south, east and west. In this case only the excess was fed into the grid.
- In 2015 the project was extended with a ground-mounted system of a capacity of 3.2 kWp oriented solely southwest. In this case only the excess was fed into the grid.

Within a year the complete system generates 21 MWh of electrical energy. The total consumption of electric power in the household amounts up to approximately 23.5 MWh. As due to economic reasons only the PV-electricity from the last two PV systems (19.9 MWh) is used directly, only 3.6 MWh of external energy has to be bought additionally.

For the first PV system (4 kWp system), installed in 2006, a Feed-in Tariff of 0.56 € per kWh was granted for a duration of 13 years. Because of economic viability, the whole PV-

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electricity is fed into the grid (4,089 kWh) and records a revenue of 2,290 € annually. For this system, the capital expenditure amounts to 20,000 €. Those for the other systems - including an energy storage device (battery), a power inverter and data acquisition - add up to 68,000 €. The total amount of the expenditure for the three PV systems was 88,000 €.

The other two PV systems (total size of 17.2 kWp) receive a Feed-in Tariff with a market value of 0.05 € per kWh only. Therefore the own consumption should be increased to a maximum. Here the PV energy is consumed on the premises and the consumption amounts up to 95 percent, which results in a total sum of approximately 45 € per year (*5 % of 18,100 kWh are refunded with 0.05 € per kWh = 45 € per year*).

Due to this increased consumption of own PV energy the savings (0.17 € per kWh) account for 2,900 € per year (*consumption of PV energy 95 % of 18,100 kWh * 0.17 € per kWh = 2,923 €*). This amounts to an annual yield of 5,258 €. The PV system was self-financed, which results in a return of 6.5 percent. The payback time is 15.4 years (including the battery and data acquisition).

By various means the annual average of the consumption of the own electricity was increased up to 95 percent. The expenditures for electric energy could be reduced from more than 3,250 € down to 580 € per year. The entire project was developed single-handedly, as the house owner is a trained electrical engineer. So far the operational costs amount to 0 €.

Except for the ground-mounted PV system, the administrative workload to obtain an official permit was acceptable and not difficult. For the ground-mounted system a rededication of building space as well as static and structural calculations had to be submitted. As the PV system is situated next to a river, its stability and reliability has to be ensured in case of a flood.

In 2006 for the first PV system a tariff subsidy was applied for and granted without any difficulty. As per meter point only one subsidy is allowed, other tariff subsidies were out of the question for the expansions of the PV system. But because of the enormous own consumption no subsidies are required.

Above all this project was realized to gain experience with energy self-sufficiency, which in turn ought to benefit to those who are interested in this project. Essential were also the cost reductions by minimizing the purchase of additional energy.

Technical project parameters

Outstanding in the described project is the PV system alignment in various directions and the optimizing consumption to the smallest detail. Hereby the own consumption takes priority and is regulated in a strictly determined sequence:

Step 1: Covers the current consumption of energy within the building

Step 2: If the consumption of energy is covered completely, the excess is used for charging batteries

Step 3: If there is still energy left after charging the batteries, the rest energy may be used to heat water in a boiler with a heating element. The additional energy can be fed into the grid.

Approximately 5 percent of the produced energy is fed into the grid – which is a good value compared to the relatively big PV system with a high production rate.

By planning the PV system, the planner and later on system operator has refined and improved the electric controls step by step. Seven smart meters gather all data concerning the consumption and production of PV energy. Various aspects (e.g. own consumption, grid supply, grid feed-in and charge of battery) are visualized and this data can be read off via computer.

Via visualization the system can be monitored and commanded by remote control. The energy consumption is regulated according to the current performance of the PV system. When a passing cloud or altering conditions of illumination diminish the power yield, the consumption is adjusted accordingly.

A lead gel battery with a capacity of 40 kW has been selected for the energy storage. In order to conserve the battery's operational life of 12 years, the depth of discharge has to be adjusted according to the seasonal power generation. In summer for instance the battery can be discharged down to 53 percent, whereas in winter (with less sunshine) only down to 65 %.

During the night all unnecessary electric devices are disconnected (e.g. cooling units, heating elements in boilers, towel dryers and so on). In the daytime for instance the freezers are set to minus 19 degrees and all refrigerators' default settings are lowered by at least 2 degrees. During the night they are completely disconnected from the grid, to ensure that no electricity purchase is possible. Switching off the fridges/freezers doesn't have any negative effects on the refrigerated products. Outside business hours in the office building (the warehouse, the workshop and the office) all electric devices (with the exception of the server, the video surveillance, the alarm system and the telephone system) are disconnected from the grid via a central controller.

In the entire building the lighting area has been energy-optimized (LED), so during the night the energy consumption was reduced to a minimum and the supply via battery functions without a problem.

A small wind power station with a capacity of 1.5 kW completes the overall concept.

Stakeholders / companies / PPA

The entire building and the PV system belongs to one person, Mister Reinhold Wultschnig. Three out of four flats are inhabited year round, only one is rented as a vacation home. The flats as well as the operational building are supplied with home-made electricity. Although there are several flats in the building, the distribution of PV energy to all entities is no problem due to one meter point. Since only the building owner pays the electricity fees, separate invoices with several electricity meters are not necessary.

Replicability / Outlook

The most significant arguments for this or similar projects are their energy independence, their fail-safe operation and the active contribution to environmental protection and its contribution to the *energy turnaround*.

This project could be applied to other apartment houses in other countries as well. Essential is to possess the corresponding know how and a certain amount of inventiveness. But an effective implementation might be problematic, if more than one independent consumer is provided with PV energy (e.g. in multi-family households or shopping centres), as there is no efficient and legally permitted possibility for it in Austria.

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Photos

Picture 1: PV system on the building, source: Elektro Wultschnig

Picture 2: Storage system and converters, source: Elektro Wultschnig

1: Monitoring system source: Elektro Wultschnig