Evolution of the Pricing Strategy in the Photovoltaic Market

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Abstract

With less than 2% of new renewable energy production, Switzerland is a poor performer in international comparison. A study carried out for the Swiss Federal Office of Energy showed constraints explaining this low number. One of these is a need for companies to optimize their sales process. GROUP-IT has responded to these needs by developing an approach of grouped tendering of solar panel installations. This article looks at how solar panel installation companies are improving their pricing strategy over time, and how to measure this evolution. In this study, we worked in two steps. A first grouped tendering collected about 2,500 offers. At the end of the tendering process, each company that participated received feed-back, with the aim of improving the process. A second tendering collected 637 offers. The interpolation between the CHF/kWp ratio and the total investment in CHF was then calculated for each company. Cross-sectional analysis shows that the average of R-square is closer to one in the second phase, which can be interpreted as a better consistency in the construction and in the pricing of the bids. The increase of minimum values shows that the companies furthest away from the theoretical model have made significant progress. Our study therefore shows that with proper support, the solar panel installation companies are more competitive and can help accelerate energy transition.

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Introduction

On January 1st, 2018, the Swiss Confederation activated its 2050 Strategy masterplan, which had been first published in 2013 (Confédération Suisse, 2016). This plan had been developed to allow Switzerland to get rid of nuclear plants on his territory, by decreasing the energy consumption and increasing the new renewable energy production. Three indicators are used to measure the achievement of this plan: the average energy consumption by inhabitant, the electricity consumption by inhabitant and the new renewable energy production. Under this plan, new renewable energy production in Switzerland should reach 4'400 GWh in 2020 and 11'400 GWh in 2035. In order to reach this third goal, financial and legal incentives have been setup. At the end of 2018, the Swiss new renewable energy production was 3'877 GWh, still 83% of the goal set.

A study carried out for the Swiss Federal Office of Energy showed three constraints explaining this low number (Genoud et al., 2019). Firstly, a lack of consumer knowledge: even with financial incentives, owners need a neutral advisor to help them taking decisions. Second, a need for financing also with a profitable installation: if their capital is not sufficient to finance the installation, owners are not able to secure the necessary funds. Finally, a need for installers to optimize their sales process, because the success rate (15%) of offers is not good in comparison with the time spent writing these offers. GROUP-IT (2020) has responded to these needs by developing, within the Energy Management Lab (EML) of the HES-SO Valais-Wallis, a grouped tendering approach for the installation of solar panels. The aim of GROUP-IT is, in the first instance, to install PV solar panels on the roofs of registered owners, but also to coach the installers to enable them to better support the energy transition. With more than 3'500 files processed and 400 installations to its credit, the EML team has access to valuable data to understand the market mechanisms around this key objective.

This article examines at how solar panel installation companies are improving their pricing strategy over time, and how to measure this evolution.

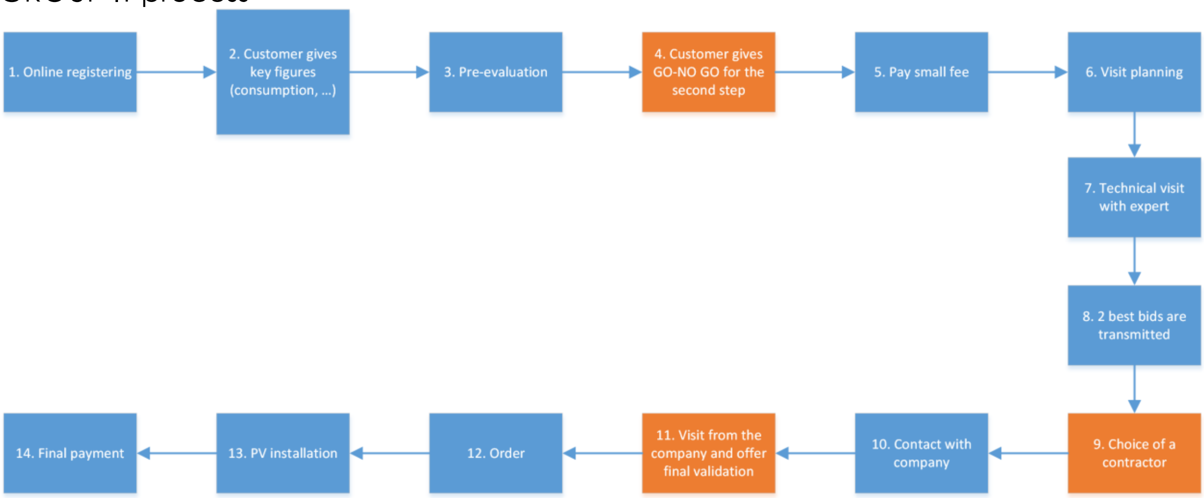
Methodology

The main variable describing the quality of a solar installation is its peak power (kWp), which depends on environmental and technical parameters (Buresch, 1983). Environmental parameters cannot generally be tailored to a specific building, as they are determined by the location of the building, the orientation and tilt slope of the roof, the size of the roof and nearby constructions (Gong & Kulkarni, 2005). The technical parameters can be modified by changing the quality of the solar panel, its technology and efficacity. These technical parameters usually have an impact on the price (Candelise et al., 2013), so that trying to optimize a solar installation is equivalent to paying the minimum possible price for the maximum peak power of that installation (Kerdan et al., 2017). It is possible to reformulate this principle by paying the minimum possible price for the installation and at the same time obtaining the minimum price per peak power. As these two optimization objectives are conflicting, this leads to a Pareto optimum, representing the best investment for the roof surface. A list of typical prices for solar installations per peak power already exists in a study conducted by the Swiss Federal Office of Energy (Swiss Federal Office of Energy, 2020) and is used as a reference function. The first assumption that will be used throughout our article is that the federal board used this equation to evaluate the cost of each roof, based on the installed capacity. The second assumption is that the function performed by the Swiss Federal Office of Energy is optimal, so approaching this function will allow to say that the price of the solar installation is optimal. As it will be shown below, it is indeed the function that defines the optimality of the offers, not necessarily the level of the curve.

In order to assess a company's alignment with the reference function, a sample of offers is taken and for each offer the peak power and the total investment price are extracted. The price per peak power (CHF/kWp) is then calculated by dividing the total investment price by the peak power. The interpolation between CHF/kWp and total investment is calculated using the same family of functions as the reference function, as well as the R-square value. The R-square value represents the quality of the sample. With R-square value close to 1, the alignment with the reference function is good and the sample is considered to be Pareto-optimal. With a R-square value close to 0, the alignment with the reference function is poor and the business logic for preparing the quotation is not adequate.

Bids are collected using the GROUP-IT process, which is designed to bring owners and bidders together. All phases are shown in Figure 1. The phases of interest for this document are the registering phase, the visit phase and the collection of bids. During the registration phase, owners who want to build a PV installation on their roofs have the possibility to register on a website. All owners are then divided in lots of about 20 buildings. The visit phase is carried out by an independent expert, who has been appointed by GROUP-IT. After the visit, a file containing all the information necessary for a quotation is drawn up by this expert. One of the compulsory parameters in the file is the minimum peak power of the planned installation. All companies bidding for a lot then receive the same list of buildings and the same information on the buildings and associated roofs. Companies are not allowed to visit the building on their own. The key figures of the bid are collected on the same template for all companies.

Figure 1
GROUP-IT process



Source: Genoud et al. (2019)

In order to evaluate the evolution of the quality of the offers, two successive calls for tenders are carried out with the same GROUP-IT process. The offers are sorted by price, the most advantageous being the first. Then all the companies receive their ranking according to the sorted prices. Afterwards, a second invitation to tender is made on new lots, with exactly the same procedure and the same sorting. As the location of the lots is different, the prices will increase if the distance from the roof to the company increases, adding unwanted noise to the samples. To eliminate this phenomenon, each lot from each company is evaluated, and the average R-square values are then calculated and assigned to the company. A cross-sectional analysis is also performed on the companies that responded to the two tenders. This cross-sectional analysis will make it possible to compare the evolution of the R-square value for the companies that participated in the whole process compared to the all companies.

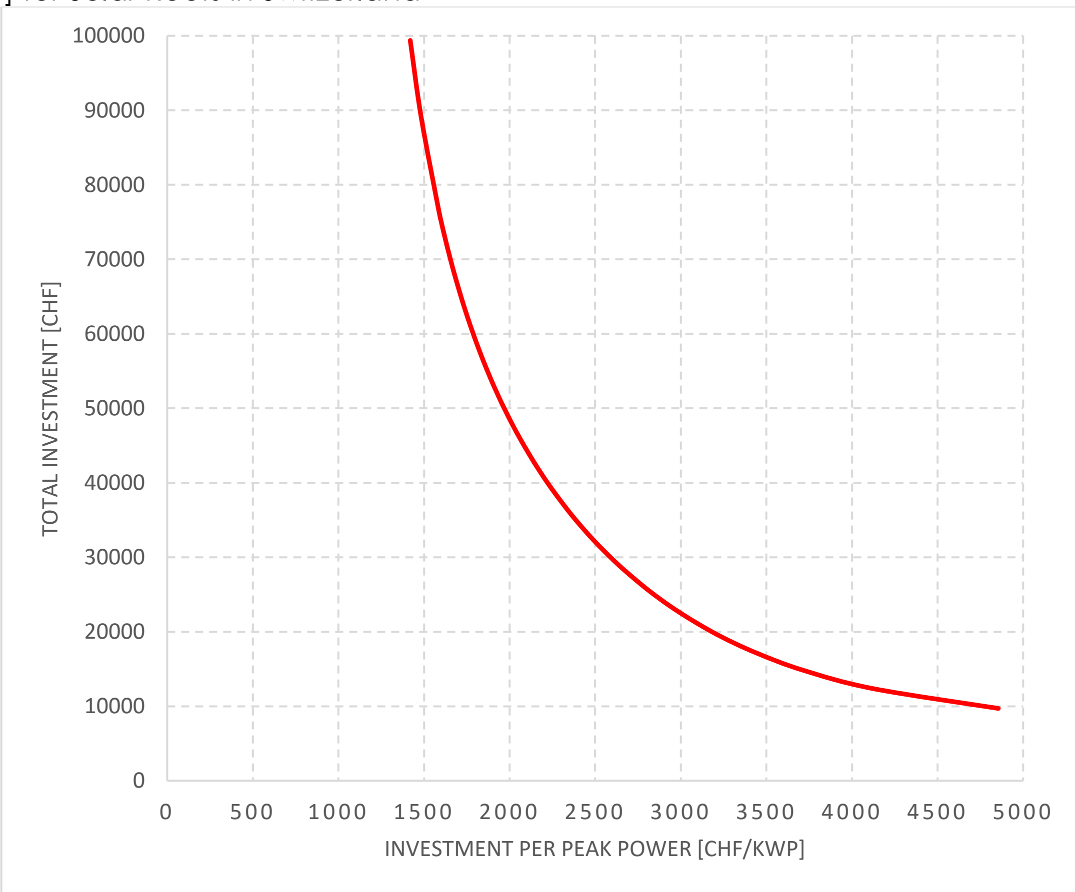
Finally, a new Pareto-optimal limit for solar installations in Switzerland is reconstructed by taking the best bids of the second tender for each roof size. This new Pareto-optimal limit is compared to the reference cited at the beginning of this document.

Results

Reference curve from Swiss Federal Office of Energy

The relationship between the investment per peak power (CHF/kWp) and the investment of a solar roof according to the Swiss Federal Office of Energy is shown on Figure 2. The best correlation is a power correlation with an almost perfect R-square value of 0.9992. To extract the constants and coefficients, x and y values have been linearized by taking the natural log and are shown in Table 1.

Figure 2
Relation Between the Investment per Peak Power [CHF/kWp] and the Investment [CHF] for Solar Roofs in Switzerland



Source: Authors

Table 1
Correlation Parameters (linearized) for values in Figure 2

	Coefficients	Standard error	T-stat	P-value
Intersect	25.116	0.047	526.569	0.000
ln(price/kWp)	-1.884	0.006	-303.458	0.000

Source: Authors

Calls for tenders

The first tender procedure involved 394 buildings divided into 20 lots for which a total of 2210 bids were received. At this stage, 38 companies participated and each lot of about 20 buildings received an average of 11 bids. One company responded with the same CHF/kWp for all bids and was removed from the analysis due to the impossibility of calculating the interpolation. A total of 68 offers where removed from the total, bringing the number of valid bids to 2142. The companies' average R-square value was 0.655, the minimum R-square was 0.205 and the maximum R-square value was 0.957.

The second call for tenders, which brought together 67 buildings divided into 3 lots, resulted in a total of 637 bids from 16 different companies, each lot receiving an average of 10 bids. The average R-square value of the companies was 0.733, the minimum R-square was 0.537 and the maximum R-square value was 0.894. The essential figures of the calls for tenders are summarized in Table 2.

Table 2
Bids Collected, Companies participating, Average, Minimum and Maximum R-square values for Bid 1 and Bid 2

Result	Bid 1	Bid 2
Number of Valid Bids collected	2142	637
Companies participating	38	16
Average R-square	0.655	0.733
Min R-Square	0.205	0.537
Max R-Square	**0.957**	0.894

Source: Authors

Cross-sectional analysis

A total of 13 companies answered to the two calls for tenders and the results are presented in table 3. For these companies, the average value R-square increases from 0.682 to 0.737. The minimum R-square value increases from 0.206 to 0.537. The maximum R-square value decreases from 0.957 to 0.894. Eight companies recorded an increase in the average R-square value, and five companies recorded a decrease. All but one of those five companies had a R-square value above the average.

Pareto-optimal front

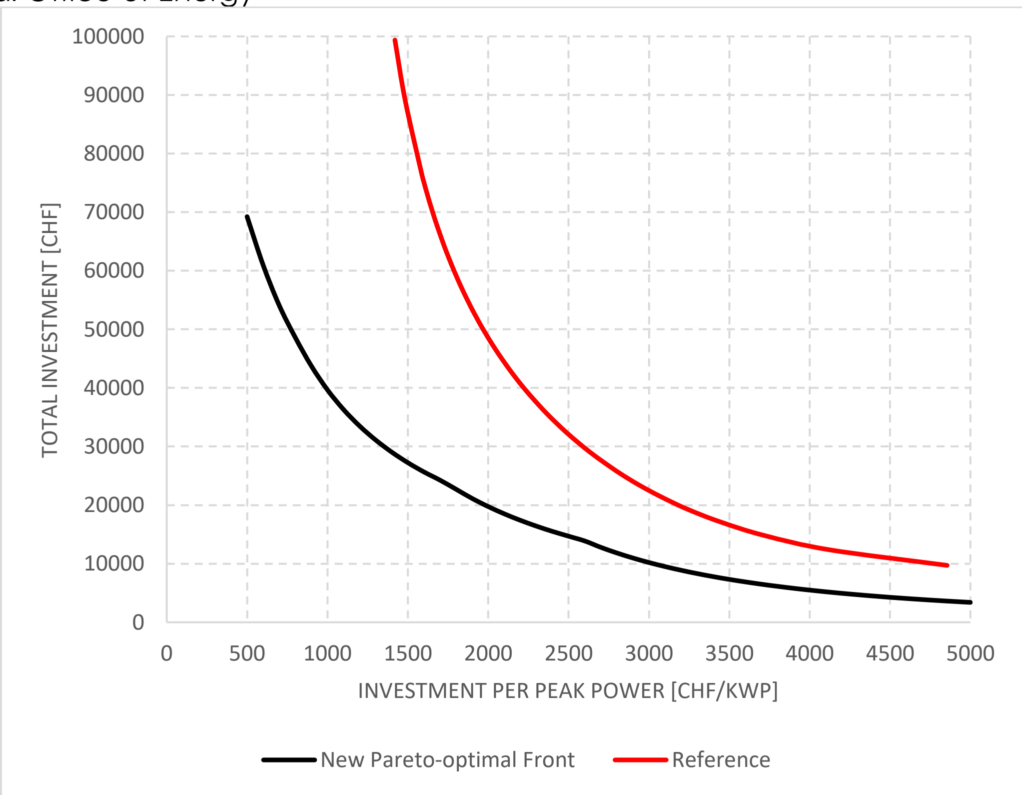
The reconstruction of the pareto-optimal front is shown in Figure 2. The curves have the same shape, but the new pareto-optimal front is offset by a value of about 1'000, which means that for the same price, the price per kWp is CHF 1'000 lower than the reference.

Table 3
Evolution of R-square Values for Companies that have answered to both Bids

Company	Bid 1	Bid 2	Change
1	0.519	0.643	**0.124**
2	0.669	0.764	**0.095**
3	0.614	0.592	**-0.021**
4	0.957	0.894	**-0.063**
5	0.762	0.576	**-0.186**
6	0.628	0.820	**0.103**
7	0.869	0.835	**-0.033**
8	0.804	0.823	**0.019**
9	0.598	0.657	**0.059**
10	0.786	0.859	**0.073**
11	0.524	0.832	**0.308**
12	0.926	0.537	**-0.389**
13	0.206	0.750	**0.545**
Average	**0.682**	**0.737**	**0.056**

Source: Authors

Figure 2
Comparison of the New Pareto-optimal Front with the reference function from Swiss Federal Office of Energy



Source: Authors

Discussion

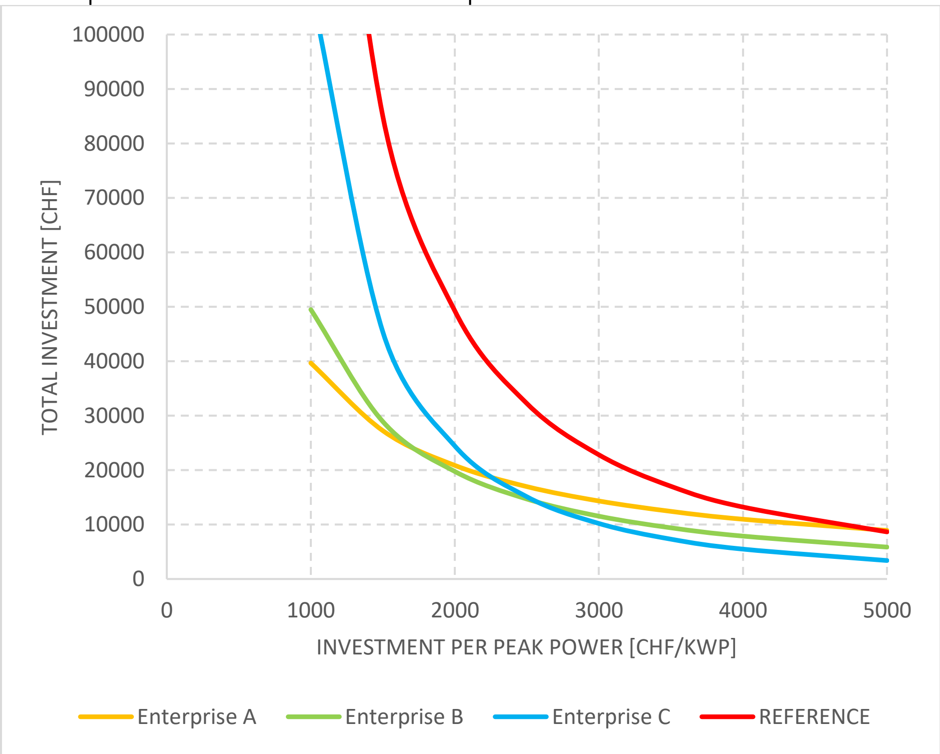
Analysis of the average, minimum and maximum R-square value of the two tenders shows a general increase in the quality of the bids. Therefore, according to our assumptions, the increase in the minimum value is notable because it proves that poor performers improved their internal calculation between the two calls for tenders. The cross-sectional analysis carried out on the companies that responded to the two calls for tenders shows the same trend. In the second call for tenders, a majority (13 out of 16) of companies made a bid for the second time and knew their positioning. Their average R-square value was slightly higher than that of the other 3 companies that were bidding for the first time, but the sample size is unfortunately too small to draw any valid conclusions.

The maximum R-square value decreased slightly, indicating that there is a ceiling. This study took peak power as the main characteristic, but it is not the only parameter taken into account when writing a bid, so it is impossible for a company to align perfectly with the interpolation. A non-exhaustive example of other parameters that can have a significant impact on the price could be:

- The distance between the company's office and the property, which results in higher costs for the same size roof if the distance is significantly greater;
- The types of scaffolding that need to be installed to protect workers from possible falls;

With these results, it can be said that companies' offerings are moving closer to Pareto's optimal front over time, with the hypothesis, resulting in better value for customers.

Figure 3
Pareto-Front Representation of Three Companies



Source: Authors

A detailed analysis also shows that the companies are specialized in a range of roofs and are the most successful in the offers corresponding to this range. Figure 3 shows the Pareto front of 3 companies that have contributed significantly to the establishment of the new optimal Pareto front. Each of these companies will be the best performer in a certain roof category: with installations costing more than 25'000.- CHF, or large installations, company A will be the most competitive, with the smallest investment per peak power being less than 1’750.- CHF/kWp. For investments between 15’000.- and 25’000.-, or medium sized installations, company B will be the most competitive. For investments less than 15’000.- CHF, it is company C that will be the most competitive.

The establishment of the new optimal Pareto front shows an investment per peak power that is 1'000 CHF/kWp lower than the existing statistics, as seen in Figure 2. This significant difference can be explained by the very strict tendering procedure, which obliges companies to respond according to a comparable framework and creates competition between companies. In this sense, one can only see the beneficial effect for potential customers of using a similar process, or at least of asking for several bids and letting the companies know about it.

Conclusion

A method for measuring the quality of companies' offers in the installation of photovoltaic solar panels has been proposed. This evaluation method was used in two successive calls for tenders according to the Group-it process. The results show an improvement in the quality of the internal calculations of the companies that know they are competing. The use of a strict process with competition allows to estimate savings of about 1’000 CHF/kWp compared to the current statistic, which is a notable result. This raises the question of the relevance of the reference values used by the Swiss Federal Office of Energy, as the difference between our results and those used by the Swiss Federal Office of Energy is still very high. On the other hand, our hypothesis about the shape of the equation seems to be confirmed.

This study has shown that there is a ceiling in the improvement of offers and that it would be interesting to study the reasons for this ceiling. A study that would highlight the positioning of the companies in relation to the roof sizes where they are the most efficient and their Pareto Optimum would also be interesting.

We must now, in a future article, justify the shape of the power curve, this with the data of the offers we received, data that includes the elements of the offers of the companies divided into 26 basic parts and 9 optional parts.

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