Diese Studie wurde in englischer Sprache verfasst. Nur die Zusammenfassung wird vorab auch in schwedischer Sprache angeboten.

This research is written in English. Only the summary is offered in Swedish language as well.

Ny rundfråga: Krav på planeringsverktyg för solcells-system i Sverige

Majoriteten av de professionella användarna av planeringsverktyg för PV-anläggningar i Sverige önskar ett online-baserat kommunikations- och planeringsverktyg som på ett optimalt sätt hjälper dem att organisera och strukturera deras försäljningsaktiviteter och projektprocesser. Detta för att moderna solenergianläggningar har en ökad komplexitet och det finns en avsaknad av effektivitet i kommunikationen mellan slutkunder, planerare, installatörer och distributörer. Dessa utmaningar kommer troligtvis att öka så snart trenden att förbättra ett systems ekonomiska effektivitet genom högre nivåer av självkonsumtion (laststyrning, elbilar, laddningssystem) slår rot i Sverige.

Detta är en del av resultatet från en gemensam undersökning med Lucas Lundberg från Mälardalens Högskola, och med support från Glava Energy Center i Sverige och den tyska PV-distributören EWS GmbH & Co. KG. Syftet med arbetet var att efterhöra hur ett planeringsverktyg för den svenska PV-marknaden kan designas, ett verktyg som är enkelt och intuitivt att hantera och samtidigt detaljerat, omfattande och tillräckligt precist för att underlätta planeringen och installationsprocessen samt leverera pålitliga resultat.

För detta syfte var 35 solinstallatörer och konsulter intervjuade angående deras behov och förväntningar vad gäller en optimal lösning av programvara. Fynden analyserades och summerades. Majoriteten uppgav att det eftersträvade online-verktyget bör vara användarvänligt, detta för att de intervjuade ska kunna dela projektprocesserna med sina kunder i realtid via en white-label-version implementerad i deras hemsida. Ett huvudsakligt krav på ett sådant verktyg är att det kombinerar den tekniska planeringen direkt med en beräkning av kostnaden, energiutvinningen och de ekonomiska resultaten. Nästintill alla intervjuade förväntade sig en funktion att kunna ställa in graden av själv-konsumtion och utvecklingen av elpriset blir mer och mer viktigt i ett planeringsverktyg. På grund av detta önskade över 80% av intervjupersonerna en möjlighet att individuellt kunna justera mätningar för laststyrning (t. ex. en värmepump, elektriskt fordon eller stationär batterilagring). Vidare indikerade 97% av de tillfrågade att verktyget bör inkludera en funktion som underlättar arbetet med uppföljning av ordrar och kommunikationen med slutkunder.

Alla de intervjuade delar en positiv förväntan för utvecklingen av PV-marknaden i Sverige. De politiska besluten att på medellång sikt fasa ut kärnkraften ökar pressen på att utveckla förnybara energier i Sverige, om de beslutade klimatmålen ska uppnås. Idag täcker förnybara energier mer än 50 % av landets behov av elektricitet och målet för den officiella energiöverenskommelsen är att höja det till 100 % år 2040. Om den planerade solpotentialen på mer än 30 GWp skulle bli utnyttjad skulle en PV-kapacitet som är hundra gånger större än den nuvarande siffran 0,3 GWp bli installerad i Sverige.

Så snart de ekologiska och ekonomiska fördelarna av de mindre centralstyrda nätkopplade PV-systemen har blivit kända för en större publik i Sverige, och därmed resulterar i en ökad efterfrågan, kommer solinstallatörer möta stora utmaningar i att marknadsföra och designa individuellt planerade installationer. Därför kommer ett digitalt tillvägagångssätt för försäljning och distribution bli nödvändigt för att kunna optimera alla processer. I alla fall kommer den framträdande kvaliteten av kommunikationen mellan partnerna som är involverade i ett PV-projekt att öka kraftigt parallellt med en ökad press på planerings- och förverkligandeprocessen. Kunderna kommer att kunna förvänta sig en ännu kortare reaktionstid och mer attraktiva erbjudanden från leverantörer, medan de behöver hantera en mer och mer komplex utbudssida. Fokus med dessa undersökningar var att utveckla ett verktyg som kan hjälpa professionella användare att generera mer och mer förkvalificerade kundkontakter.

Hochschule Flensburg

B A C H E L O R – T H E S I S

Topic: Developing a planning- and communication tool for solar power plants in Sweden

Author: Paul Dahm

Date of submission: 20.02.2017

Preface

Motivation

I have grown up with the awareness of the climate change and the upcoming challenge of meeting an exploding future energy demand while, at the same time, saving resources and protecting a hospitable planet. Early on in my life, I decided that I want to assume an active role in this question, meaning I dedicated myself to the global energy transition. Having learned about the different sources for renewable energy, in recent years my focus has shifted towards the opportunities of photovoltaics, because of its manifold advantages: The costs of a PV system have dropped in recent years, thus making an investment more affordable and profitable. Photovoltaics also has the highest potential for increasing efficiency rates among the renewables. What is more, it can contribute to the decentralisation of future energy production, thus reducing the costs of an expansion of the grid.

Therefore, I started engaging in this sector. In addition to my studies in Renewable Energy Techniques I gained many experiences in and of the German solar-market through various internships. But the German market is likely to stagnate, while the Swedish market is young and open for new influences. Therefore, I decided to take an internship at the Glava Energy Center in Sweden, where I got to know the Swedish market and its participants. Together with my personal affectation to Sweden this led me to work on this project. My intention is to use experiences from the German market in order to advance the expansion of photovoltaics in Sweden.

Cooperations

This thesis was developed with the help and support of many people and institutions. But first and foremost, it is the joint work of me and my Swedish partner-student in this project, Lucas Lundberg. Thanks to our different fields of study and backgrounds, we were able to combine our individual strengths in this project: I could provide good contacts to the German partner company, as well as theoretical and practical know-how of the more advanced German market. Lucas' knowledge of the Swedish language and society were immensely administrable when it came to collaborating with Swedish interview-partners and institutions.

Lucas Lundberg writes his own master thesis, taking the following outcome as a foundation. This and the fact, that we did all research and information-collection together, can cause analogously parts in Lucas thesis. Lucas finished thesis will furthermore illustrate the results of potential further investigations.

This follow-up thesis will be named: **"Optimization of tools and structures for the cooperation between installers and multiplicators in the Swedish PV-market"** and published in the end of July 2018 on the webpage of the Mälardalens Högskola.

Acknowledgements

In the two months that I spent on researching, writing and collecting information and expertise, I received kind support from many people and institutions. My special thanks go to:

- The EWS GmbH & Co. KG (EWS) for offering this interesting project and for supporting me financially and with all available expertise, time and advice.
- The Glava Energy Center and especially Magnus Nilsson for all the time and patience, that he invested in this project, as well as providing accommodation and office-space in Central-Sweden.
- All the participating installation- and consultation companies that gave their time, answers and feedback.

Table of contents

I Introduction

1 Initial situation

Renewable energies already provided approximately 46 % of the Swedish electricity consumption in 2007, mostly by water power, which can be seen in Figure 1. Since the economic and ecological usable potential of water power as well as of biomass was already nearly exploited, primarily wind power has been promoted in the last years. Therefore, wind turbines are currently regarded as the most important technology for the expansion of renewables in Sweden. The political decision of phasing out nuclear power in the medium term increases the pressure of extending renewables in Sweden, if the set climate-goals are to be kept. Today renewable energies cover more than 50 % of the country's electricity consumption. [1]

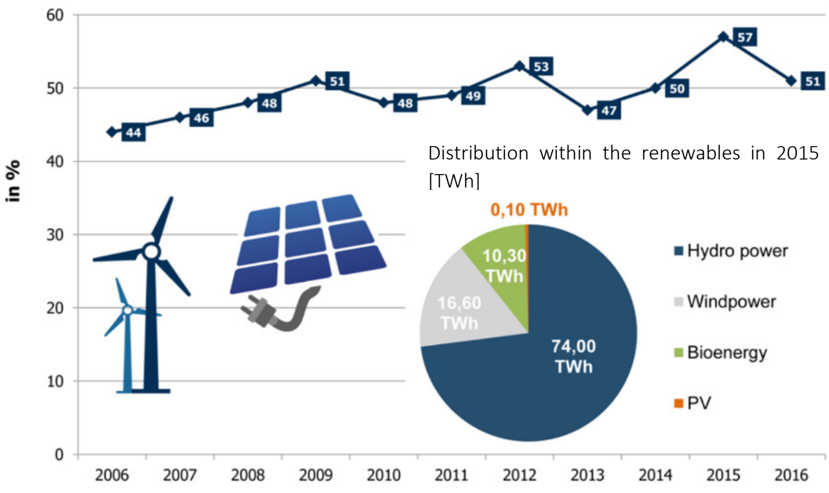


Figure 1: Share of renewables in the Swedish energy-mix 2006-2016 [1]

1.1 The Swedish PV-market until today

The use of photovoltaics has played a minor role in the Swedish electricity market so far. However, due to the continuously falling prices for solar components and the huge economic potential for self-consumption of solar electricity in private and commercial applications, an increasing use of photovoltaics is likely to be seen. This assumption is enforced by the positive development of PV-installations since 2012, which can be seen in Figure 2. Although the specific price for a solar electric system has been twice as high as today, the demand for solar installations has almost risen exponentially in the same period of time. [2]

A thorough analysis of previous installations in Sweden, according to their categoric and geographic classification has been difficult, due to a lack of reliable statistic data, as, for instance, it is provided in Germany by the Bundesnetzagentur. The best data set seems to be extrapolations done by the Swedish Solar Energy Association (Svensk Solenergi). Figure 2 shows the distribution of the yearly installed capacity according to the plant capacity. A differentiation has been made between grid-connected installations and so-called stand-alone-units.

A comparison of the numbers for grid connected solar power plants within residential- and commercial installations shows a nearly balanced development until 2015. Small- and medium-sized installations, which serve most likely for self-consumption, account for a major share. Centralized systems, which are targeted for full feed-in did not find a ready market until 2015. [2]

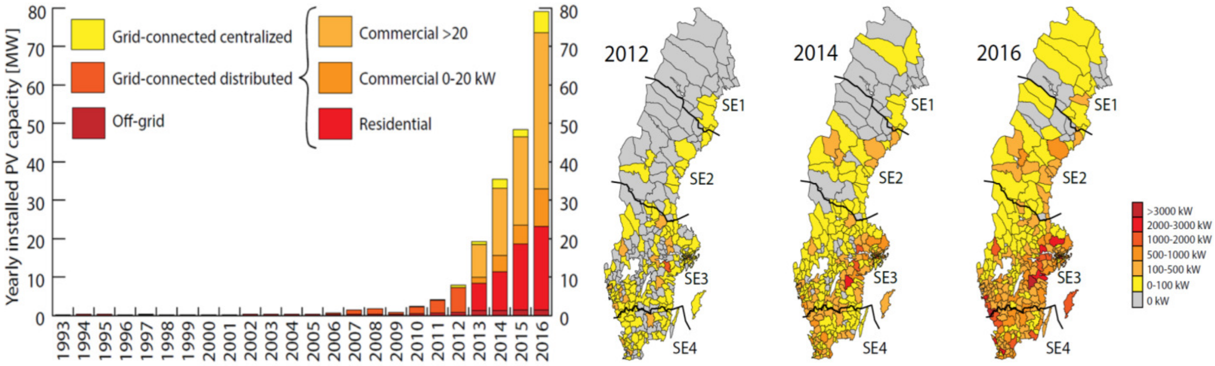


Figure 2: Distribution of the PV-extension in Sweden regarding plant capacity (left) and location (right) [2]

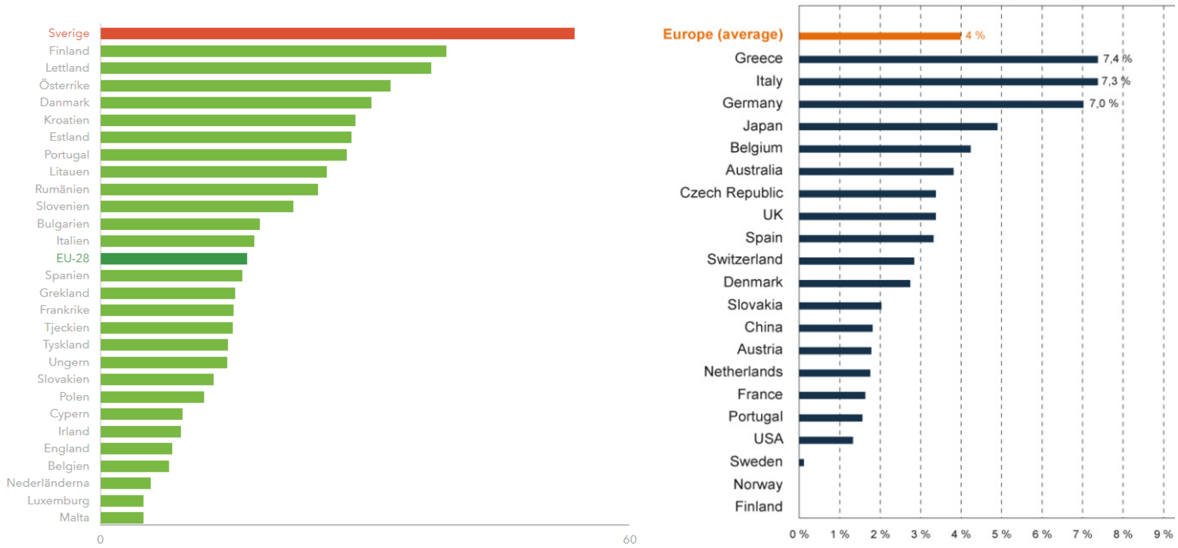
Figure 2 also illustrates the geographic distribution of the PV-extension in the years from 2012 to 2016. The two sparsely populated northern parts of Sweden (marked with SE1 and SE2) saw no or only a slight growth of solar installations (with capacities from 0 to 100 kWp) in selected areas until 2014. Since then the trend has been more positive, even though the lion's share of the installations is registered in the two southern parts of Sweden (SE3 and SE4). [2]

Provided that this trend continues to increase, solar installers will consequently be confronted with a higher volume of inquiries that will be spread across the whole of Sweden. In order to manage this situation as successfully as possible, a project management is required, which allows solar installers to satisfactorily process as many requests as possible without having to travel long distances to more remote locations. Furthermore, will the consultation process become more complex and time-consuming, as the public demand for measures to increase the level of self-consumption rises. These could be load management, storage systems or e-mobility and are a major focus in further developed markets like Germany.

The development of the demand for stand-alone-units, mainly used for caravans, sailing yachts and weekend cabins does not matter in the following chapters, because this has no impact on the Swedish energy economy.

1.2 Experiences from further developed EU-markets

One approach of estimating the currently unused potential of the Swedish PV-market could be to compare it to other countries. The following figures show the share of electricity demand, that is covered by renewables and by photovoltaics in the listed countries.



Graph 1: Share of renewables (left) and PV (right) in the listed countries 2016 [3] [1]

As can be seen in Graph 1, the average European PV-share in the electricity mix is 4 %. This is based, amongst others, on the extension in Germany where the climate conditions for generating solar electricity are not essentially better than in Sweden. Even countries with a significantly weaker economic power, like the Czech Republic, show a much higher share of solar electricity. [3] Even though Sweden is leading within the EU when it comes to the share of renewable energy, it seems like with a share of 0.1 % solar electricity it has by far not exploited its whole potential.

1.3 Opportunities and limitations of the market

In a report from September 2017 about the chances and limitations for the development of solar power in Sweden, the research institution *Energiforsk* identifies reasons for the reticence until today. As to be seen in Figure 3, the biggest obstacle seems to be the insecure framework of the governmental support systems, which also impedes an accelerated extension in the future. Despite a projected solar potential of more than 30 GWp (currently a capacity of less than 0.3 GWp is installed) as well as a positive outlook on the economic conditions and demand of potential buyers, the authors are sceptical with regard to the speed of future implementation of solar electric generation in Sweden. In particular, they anticipate problems with the grid-connection of solar power plants, negative impacts on the grid-stability as well as technical problems with integrating photovoltaics in the building-structure. [4]

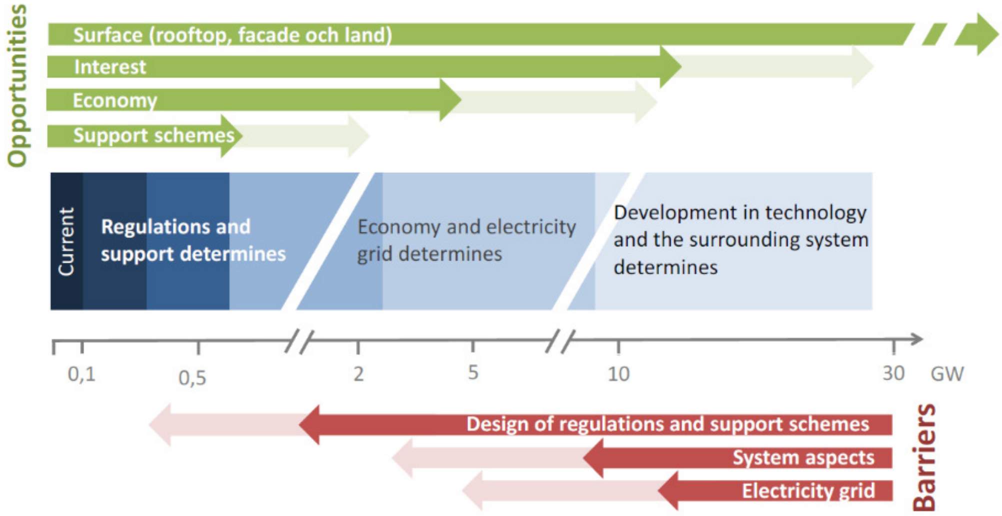


Figure 3: Opportunities and barriers for the development of solar-electricity in Sweden [4]

On a critical note, this report does not take into consideration, that all the anticipated problems did not arise in more advanced PV-markets or have already been solved: In Germany, Greece and Italy, solar installations have been integrated in the grid and building structures within three to five years which were able to cover 7 % of the electricity demand. [5] Moreover, in Germany solar installations with a capacity of more than 42 GWp have been installed to date, without threatening the net stability. [6] Even if the early growth in Germany was still ten times higher than in Sweden in 2017. [2]

As soon as the ecological and economic advantages of decentral grid-connected PV systems have become known to a wider public in Sweden, thus resulting in a rising demand, the solar installers will face huge challenges in the field of marketing and designing individual planned installations. Therefore, a digital approach to sales and distribution will be essential in order to optimize all processes.

2 Approach

As a wholesaler for photovoltaics in Germany, EWS has developed and successfully introduced an online platform for the German and Danish solar market. This tool is to be adapted to the requirements of the Swedish market in order to support its development and encourage new installations. This demands to outline differences to the circumstances given in Germany.

The translation of texts and descriptions in the program is not part of this project. It will be done by EWS itself.

2.1 Analysis of supply and demand

An analysis of supply and demand of photovoltaics planning- and calculation software will form the basis on which this thesis will be built. The supply systems and political circumstances are crucial for any economic calculation in the field of photovoltaics. As there are huge differences in the policy framework requirements between Germany and Sweden, the tool needs to be reviewed and updated.

2.2 Interviews with market-actors

In on-site presentations and subsequent interviews information on the needs of Swedish installers will be collected. These interviews will hopefully identify the most used programmes as well. These findings will be the beginning of the market-supply-observation. The interviews and this thesis will focus exclusively on the installers' point of view. The conclusions which can be drawn from the interviews/meetings with energy suppliers, building companies and official as well as financial institutions can be seen in the thesis written by Lucas Lundberg.

The structure and sequence of the interviews will be determined by an extensive questionnaire. The background of each question will be illustrated in parallel, by showing EWS' online tool *QuickPlan*.

2.3 Results as foundation for the process of optimization

The questionnaire will be formatted in Excel in order to be able to statistically analyse the answers and comments of the interview-partners. This analysis will be the foundation of recommendations, which we prepare for the development and optimization of planningtools for the Swedish PV-market.

The goal of this work is to develop a tool which is easy and intuitive to handle and, at the same time, detailed, comprehensive and precise enough to facilitate the planning and installation process while delivering reliable results.

II Fundamentals

3 Definitions

3.1 Sequence of a PV-project (only on request)

3.1.1 Initial contact (only on request)

3.1.2 Data acquisition (only on request)

3.1.3 Planning process (only on request)

3.1.4 Project administration (only on request)

3.1.5 Order processing (only on request)

3.1.6 Installation (only on request)

3.2 Sequence of the planning process (only on request)

3.2.1 System layout (only on request)

3.2.2 Cost analysis (only on request)

3.2.3 Profitability analysis (only on request)

4 Influencing factors

The energy yield, the costs and with it the economy of a photovoltaics-installation varies a lot depending on several influencing factors. The investigation of these factors is a part of this work, even if the existing program already contains calculations, that consider these factors.

4.1 Political framework

The *Swedish energy agreement* is a frame-agreement between the Social democrats, moderates, Greens party, the Centre party and the Christian democrats and commits them to the energy goals for Sweden until the year 2020, which are shown in Table 1: [11]

Goals of the Swedish energy agreement		
Area of issue	**Goal for 2020**	**Goal overall**
Greenhouse gases	40% reduction of environmental pollution compared to the level of year 1990	At the latest year 2045 Sweden shall have zero net emissions of greenhouse gases to the atmosphere, and later on achieve negative emissions
Renewable energy resources	At least 50% renewable energy	Having 100% renewable electricity production in year 2040
Energy consumption	20% more effective use of energy compared to year 2008.	A goal for the energy efficiency for the period 2020-2030 shall be presented and decide latest year 2017.

Table 1: Goals of the Swedish energy agreement [11]

The intention is, to fulfil these goals for instance by extending the green electricity certificate system (cf. 4.2.4) by 18 TWh of new certificates until year 2030. The small-scale electricity production shall be developed by adapting new products and services within energy efficiency, energy storages, load management and selling of electricity. Another intention is to start working with arrangements that are required to get a functional demand-flexibility on the on the part of the users. The electrical grids shall be expanded in a cost-efficient way. The capacity of transmission shall be increased within Sweden as well as with the neighbour countries. New rules and laws shall enable the competition in new products and services and economically effective investments in new electricity production. [4]

The Swedish Energy Agency cooperates with different types of business and sections of society to formulate a strategy for making Sweden more energy efficient. The first report will be presented in the start of 2018. Later on, more reports of this type shall be published frequently, to document the impact of executed changes. The report in 2019 shall for instance give an idea about the improvements in the field of energy storages and evaluate whether there are any obstacles left to improve the Swedish PV-market. [4]

So far, there is no uniform answer in the different regions of Sweden, whether a building permission is needed to install a PV-system. According to the Swedish Energy Agency any insecurity in the area of planning and building laws can reduce the interest in solar installations and should be clarified. [12]

Another proposal is to authorize an official institution to collect and analyse the data of every PV-installation in Sweden. It would be of national and international interest to have the statistics published in a comparable and harmonized way. The Swedish Energy Agency has published a suggestion for a statistic collection program organized by the net owner for a specific region. [12]

All these proposed measures are already realized and well established in further developed PV-markets in Europe like Germany or Denmark. The availability of reliable data about the market-development and the distribution between different regions or system-sizes is invaluable for political as well as economical decisions. The Swedish government hesitated to support the development of the PV-market in Sweden and still waits to clarify every obstacle and push measures immediately.

An example of the, so far, complicated legislation could be the energy-taxes: The superordinate rule is, that all consumed electricity is subject to taxation. But since the first of July 2017 specifications of this rule indicate: [13]

- If a juristic person owns one or more PV-systems, whose combined effect does not exceed 255 kWp, this person does not pay taxes on the self-consumed electricity.
- If a juristic person owns multiple PV-systems, whose combined effect does exceed 255 kWp but every single system’s capacity is smaller than 255 kWp, this person pays 0.005 SEK/kWh of electricity taxes for the self-consumed electricity.
- If a juristic person owns multiple PV-systems, of which only one does exceed 255 kWp, this person pays 0.3 SEK/kWh of electricity taxes for the self-consumed electricity from this system, but 0.005 SEK/kWh of electricity taxes for self-consumed electricity from the other (smaller) systems.

Creating save and reliable circumstances could be even more important than a subsidy for the demand for photovoltaics in Sweden.

4.2 Financial support schemes

This chapter describes the financial support policies for solar installations in Sweden. There are several concepts in Sweden, which depend on, or influence each other. Some of them are directly or indirectly a return of the investment cost, some ensure a payback for the self-produced and fed-in electricity. The following support concepts are only valid for grid-connected installations.

Earning money by selling self-produced electricity and saving money by buying less electricity from the grid influence the economy of a photovoltaics installation but both are not active support concepts and therefore not mentioned in this chapter.

4.2.1 Refund of investment costs

The governmental investment support for solar installations (statliga investeringsstöd till solcellsinstallationer) offers a partly replacement of the investment cost of a solar installation. Private persons as well as commercial owners can apply to get back 30 % of their investment costs. This includes material as well as working costs. There is a limited amount of money (915 million SEK for 2018). The queue time for the subsidy currently can be up to 1.5 Years, depending on the type of installation and the responsible department [14], which frightens potential owners of PV-systems and breaks the market. The applications are handled by the respective municipality. Installations supported like this, must be finished until the 31st of December 2019. The maximal support is 1.2 million SEK, which matches 122,141 € [15]. The refund of investment costs is only applicable on installations with a maximal specific cost per kWp of 37,000 SEK or 3,766 € [15] plus VAT. [16]

4.2.2 Tax-reduction (ROT-avdrag)

An alternative to applying for the refund of investment costs is to benefit from the so-called ROT-avdrag. This tax-reduction calculates on the installation cost, which is assumed as 30 % of the total investment cost. The actual tax-reduction amounts on 30 % of these costs. This leads in most cases to a ROT-avdrag of 9 % of the total investment costs. This is valid, if no higher installation costs can be proved. [17]

It is not possible to benefit from both subsidies. But it is allowed to apply for both concepts and use the ROT-avdrag as long as the application-procedure for the refund of investment costs goes on. In case of a granted application, the ROT-avdrag must be paid back. [17]

4.2.3 Compensation for feed-in

Owners of solar power plants can receive a tax-reduction for each kWh, that is fed in to the grid. This reduction amounts on 0.6 SEK or 0.06107 € [15] per fed-in kWh up to a maximum of 18,000 SEK or 1,832 € [15]per calendar year. Though only as many kWh can be recompensed as are taken from the grid in the same calendar year. [17]

4.2.4 Electricity Certificates

In order to encourage the energy transition in Sweden, the government has implemented the system of buying and selling electricity certificates. Electricity suppliers, electricity consumers who import or buy electricity at the nordic electricity exchange stock as well as electricity-intensive industries are obligated to buy electricity certificates depending on the amount of used respectively produced electricity. The quota (in % of the produced respectively consumed electricity) can be seen in the attached “Table of quota for electricity certificates”. Producers of renewable energy (not only owners of PV-systems) can receive one electricity certificate for each MWh of produced electricity from the government. These can be sold on an open market, where the seller needs to find a buyer and negotiate the price himself. One solar power plant is authorized for 15 years, but not longer than until 2045. [18]

4.3 Meteorological influences

In order to estimate the energy yield of a PV-system, the specific climatic conditions in the appropriate region have to be taken into consideration as well as the ability of the used components, to make the best out of the offered relation between irradiation and temperature.

4.3.1 Radiation

Sweden is a huge country and the irradiation can vary between 700 kWh/m^2 and 1,100 kWh/m^2. [4] Since the power of a PV-module depends proportional on the irradiation [19], a reliable radiation-database is vital. The meteorological-data for one specific location in Sweden vary between different providers as well, which is why the choice of a serious source is a key factor for a reliable calculation of the energy yield and the economy.

4.3.2 Temperature

The lower the temperature of a solar panel is, the higher is its efficiency due to the characteristics of the semiconductor technology in solar cells [19]. This is an advantage for cold northern countries like Sweden. The irradiation in Sweden is lower than in countries, which are closer to the equator. But this does not only decrease the module’s output, it decreases the surrounding temperature as well. Consequently, the temperature-behaviour of PV-modules can partly counterbalance the lower radiation-energy and they can produce properly in countries like Sweden.

4.3.3 Ventilation

Good ventilation respectively high wind speed can increase the positive effect of low temperature. This causes higher energy yields in regions with a higher average wind speed, as, for instance, on the coastline. Consequently, a good ventilation of the module is important, which lowers the attractiveness of, for example, building-integrated-photovoltaics.

5 Available planning software

To investigate the available software solutions for planning and calculating solar installations is one of the major tasks of this project. In order to be able to sort and compare the existing tools, the term "planningtool" (in dissociation from a data-collecting tool) must be defined. Focusing on the tools according to this definition, these can be distinguished depending on their segments of suppliers or targeted group of users. A majority of the tools listed in the following paragraphs are made for professional users. Most of them offer a documentation of the results that can be used to give an impression of the correlation between all the data and their impact on the outcome to the end customer.

Because there are grand differences between the offered solutions, they are separated in different categories. Some of the programs match multiple criteria. In that case they will be listed several times. Only software in Swedish and/or English language will be taken into consideration.

5.1 Definition of a planningtool

To separate a PV-calculation (-or planning) tool from tools that are offered, only to collect and sell contact-data, a definition needs to take place within this work. The ability of the software to lead the user through the process of decision-making by asking the right questions should be assessed. In order to prequalify the interest of potential PV-customers, a simple *calculation* according to the definition "the process of using information you already have and adding, taking away, multiplying, or dividing numbers to judge the number or amount of something. „ [20] will not lead to the solution. A PV-calculation tool (in terms of this work) must be able to guide the user through the process of assessing, which impact the possible adjustments have and how to optimize the size and the layout of the PV-system optimally according to specific circumstances.

5.2 Offered by manufacturers of solar components (only on request)

5.3 Offered by PV-system providers (only on request)

5.4 Excel-based planningtools (only on request)

5.5 Professional/commercial software (only on request)

5.6 Online-based planningtools (only on request)

6 The handled software

The online-programme which is to be adapted in this project is *QuickPlan*, a communication- and planningtool. To facilitate the understanding of the following illustrations, not only *QuickPlan* needs to be briefly described, but also *QuickCalc*, a PV-Calculator and *QuickContent*, a website configurator for PV-professionals. All these programs are completely developed by EWS. All of them are free from costs available in a German, Danish and an English version and are soon to come for the Swedish market. In the interviews, the tools were shown in the new Swedish version, which is described in this chapter. These descriptions will fail briefly, to get further information visit the EWS-homepage, where You can even find a demo-version.

To get an impression of the design and functions of the introduced online tools the sequence of the presentation, which was given to the interview partners, is documented in the following screenshots.

6.1 QuickPlan

QuickPlan is basically an online platform for solar electric projects. There are separate accesses for end customers and for PV-professionals. It is designed user-friendly in order to help end customers to estimate the investment in a solar power plant without the support of a professional planner. It is able to execute the visual planning as well as the calculation for energy yield and economic viability. These calculations are meant to give an overall picture and are not accurate enough to replace a professional projecting. With access to the professional-version, all incoming projects can be observed and handled easily within *QuickPlans* project management system.

The end customer can choose between 3 different ways of using *QuickPlan*. The fastest way to get in contact with the provider is just to send the personal data. In order to get a very fast impression of the expected size, costs, energy yield and economic benefits of a PV-installation, six data must be put in the second way of using *QuickPlan*. This will not result in more than a rough impression of a possible system layout but can help to decide whether an individual planning is reasonable or not. The third way is to fill in as many data as available to get as close to a realistic picture of a PV-project as possible. These data can be sent to the provider with only one click, to let him fill in the last necessary data and calculate all details and the price of the desired PV-system.

6.1.1 System layout

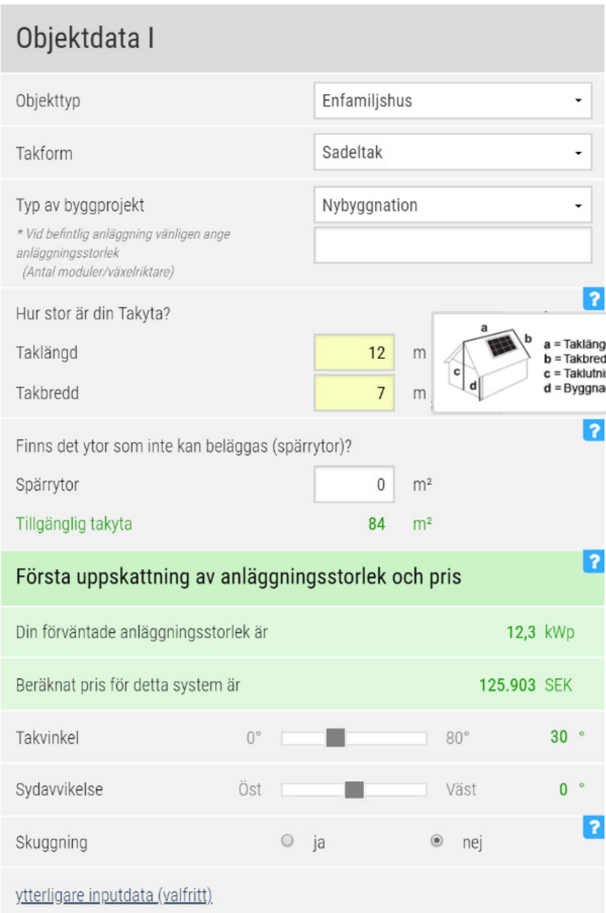


Figure 4: QuickPlan-section - Objectdata 1

The user is guided through the process of filling in the most important data. If needed, clicking on the small question mark opens a detailed description of the needed information. With the first five inputs, the programme already gives a first estimation of the size and the price of the installation. To make the calculation more accurate, the user can adjust the angle and orientation of the module-field.

By clicking on *ytterligare inputdata* (eng. more data input) the user can enter more object-data like for example the roofs underconstruction, the desired location of the inverter, preferences regarding the quality or brand of the components and many more. Furthermore, the user can choose to design a system with the maximum capacity, the highest rate of autarky or the most cost-effective solution.

6.1.2 Energy Yield

Figure 5: QuickPlan-section - Energy yield - 1

After entering the postcode *QuickPlan* automatically calculates the specific energy yield (Spec. årlig elproduktion) of the system as well as the total yield per year (Din årliga elproduktion) and over 20 years (Elproduktion över 20 år).

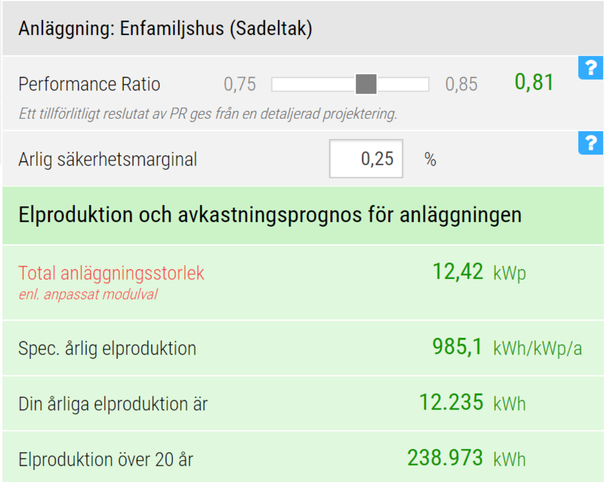


Figure 6: QuickPlan-section - Energy yield - 2

In this process the official database of estimated solar radiation, the geometry of the modules and potential shadowing is considered. Optionally, the individual losses caused by the cable diameter, mismatching of the modules or an extraordinary dust emission can be evaluated by manually changing the factor of the system-efficiency, the so-called Performance Ratio.

All inputs-data have a default adjustment that reflects the average of all possible variations. For example, the yearly security-reduction (*Arlig säkerhetsmarginal*), which considers potential performance-degradation of the modules or other unpredictable circumstances. The user can immediately see the influence of changing the values manually.

6.1.3 Economic calculation

Figure 7: QuickPlan-section - Economy- 1

Figure 8: QuickPlan-section - Economy - 2

For the analysis of the economy, *QuickPlan* combines the results of the system layout and the energy yield calculation to give different perspectives on the return on invest.

The Swedish support concepts (cf.

Financial support) have a major influence on a PV-system. Here it is possible to enter the conditions for loaning money (Finansiering) as well. Impossible or unfitting inputs lead to a fault-indication including a hint of the consequences of a possible failure.

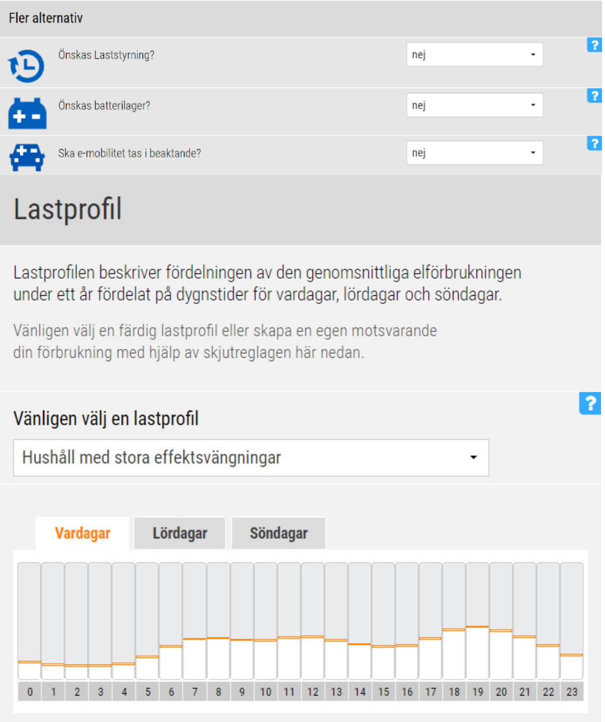


Figure 9: QuickPlan-section – Self consumption

The customer's specific profile of energy consumption can be adjusted in detail, if desired. The customer can choose between several pre-adjusted load profiles or create his own. To increase the rate of self-consumption a definite load management, the implementation of a battery storage or the use of an electrical vehicle can be elected in the program. This leads to a reliable suggestion of the specific self-consumption-quote, which has an important impact on the economy of a PV-project.

The relation between the cost of a kWh from the grid and a kWh of self-produces electricity has great influence on the return on investment in a PV-system. That is why entering the current electricity-price is only the first step. It is important to take its possible future development into the calculation as well. *QuickPlan* allows the user to enter his expectation of that development as a linear or exponential graph in the program.

In the end *QuickPlan* offers very detailed perspectives on the economic results of the calculation in figures and graphs (cf. Project-summary established in *QuickPlan* in the attachment). This documentation gives an overview of all project data and results. It can be used during the process of decision-making as well as in the phase of the projects realization to avoid misunderstanding between the different project-partners. If any detail of a project is changed in the online database, every project partner will be informed by an email sent automatically by the program.

6.1.4 Project administration

The second part of *QuickPlan* offers a complete online based project administration for the professional user.

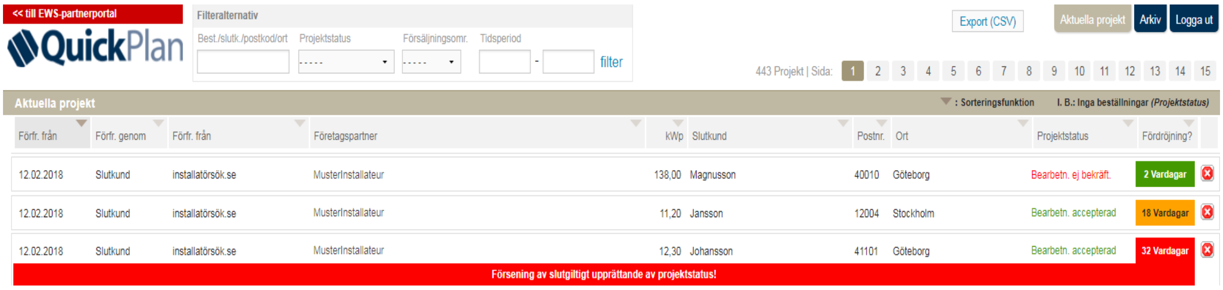


Figure 10: QuickPlan-section - Project administration

All planning-results as well as the communication within every project is documented and archived in a password-protected online area. Every professional user has an own project administration and file-folder for each project. Status-information about every project in the overview, linked to automatic highlighting and reminding emails sent by the program, help to organize the offer tracking.

6.1.5 White label version of QuickPlan

As a sales-support a white label version of *QuickPlan* can be integrated in the homepage of an EWS-customer. The integration of the program in the homepage is prepared in different versions and can be designed in several variations and colors to make it fit to the homepage's layout.

6.2 QuickCalc

In the *QuickPlan*-version for professionals the cost calculator *QuickCalc* is already integrated. This helps to create a fast and reliable overview of all project costs. In a first step, the user can quickly see and enter his individual purchase conditions.

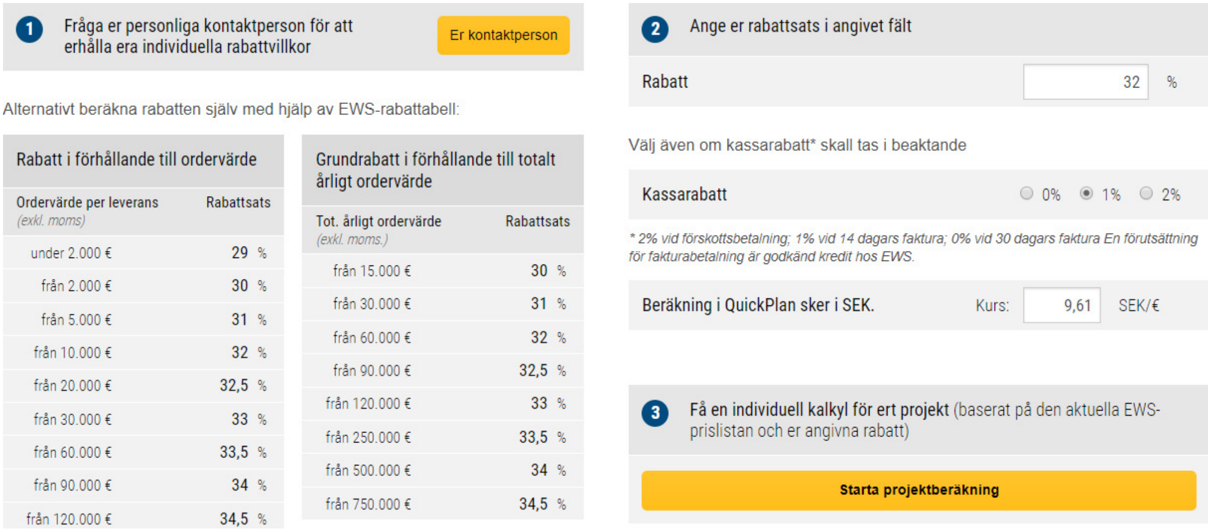


Figure 11: QuickCalc-section - Purchase conditions

Beside an online-shop system, this tool keeps all the technical data of thousands of components as well as their price. The purchase division of EWS takes responsibility for the centralised preparation of all the data, to save time and work for the *QuickCalk*-user. Based on his individual purchase conditions every user finds helpful proposals for the most efficient or the cheapest combination of components in a complete system-package. This is including the individual wishes of his end customer as well. If desired, the user can adjust the amount and the type of every component manually.

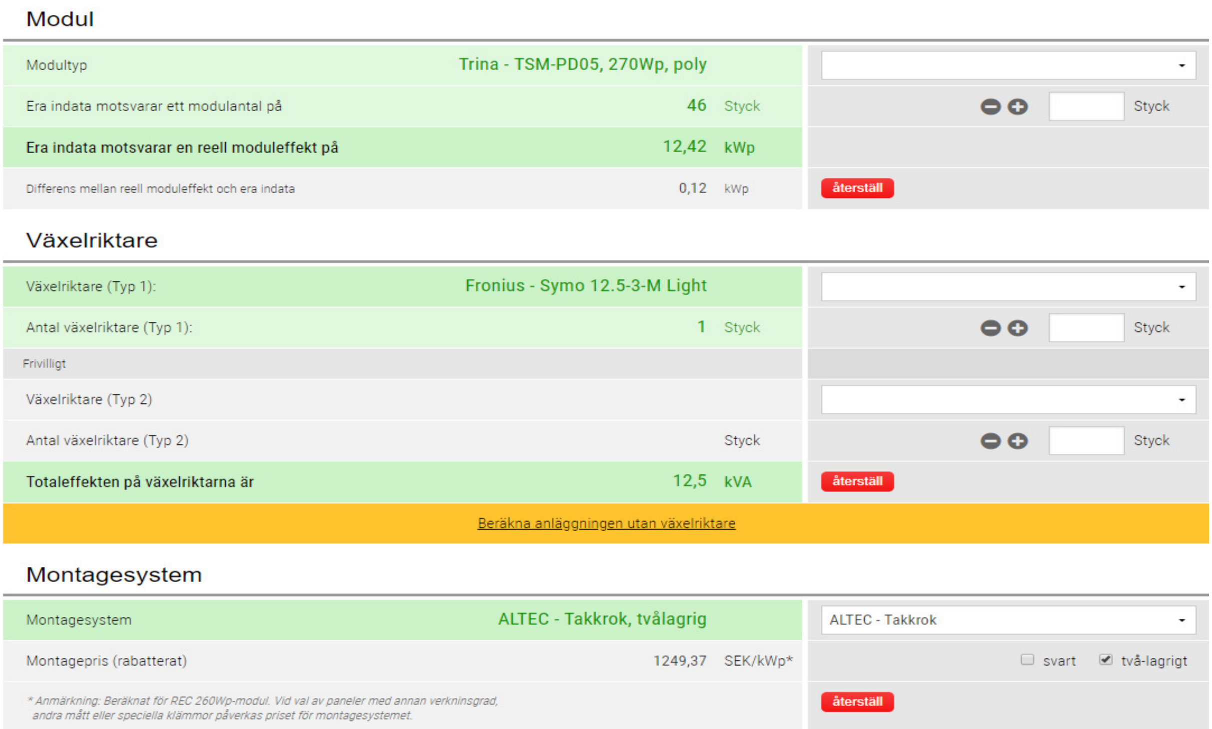


Figure 12: QuickCalc-section - Product choice

Adding his expectation of a margin on the product-prices and the installation costs, the user gets an offer, which is ready to be sent out to the end customer directly within *QuickCalk*. This offer is in his design and including the logotype of his company.

All data and the offer calculated in *QuickCalk* impact the economic results in *QuickPlan* automatically and can be used and archived in the general project documentation.

Green Energy

Icke-bindande kostnadsberäkning

Byggprojekt:

Anläggningsstorlek: 11,88 kWp (reell moduleffekt) **17. februari 2018**

Antal	Poster	Totalpris netto
44 St.	Trina - TSM-PD05, 270Wp, poly	**48.661,51 SEK**
1 St.	Fronius - Symo 12.5-3-M Light	**17.720,71 SEK**
		Totaleffekt växelriktare: 12,5 kWp
1 st.	Fronius Symo Hybrid 5.0-3-S	**18.955,06 SEK**

Ert montageval: ALTEC - Takkrok

110 St.	Takkrok Standard-basplatta 180x80	7.140,10 SEK
222 St.	Flat head-skruv	819,18 SEK
110 St.	Skruv Hammarhuvud	234,30 SEK
35 St.	Slutklammer	203,70 SEK
69 St.	Mellanklammer	425,73 SEK
21 St.	Cylindertoppskruv	22,26 SEK
35 St.	Ändlock för profil	44,80 SEK
96 m	DC-profilskena	3.323,52 SEK
	Summa montage:	**12.213,59 SEK**

Påslag fraktkostnad:	**4.000,00 SEK**
Påslag elektronik (kabel & kontakter) / nätanslutning / övrigt:	**5.000,00 SEK**
Påslag montage:	**30.000,00 SEK**

Summa kostnadsberäkning (netto)	**136.550,43 SEK**
25% Moms:	34.137,61 SEK
Summa kostnadsberäkning (brutto)	**170.688,04 SEK**

Detts system planerades med komponenter från:

Trinasolar Smart Energy Together · Fronius SHIFTING THE LIMITS · ALTEC Metalltechnik

Figure 13: QuickCalc-section - Price offer

6.3 QuickContent

QuickContent is a configurable website-extension-package, which any company can integrate on its own homepage. It is meant to upvalue homepages of the EWS's customers with a photovoltaics-information-offer in desired design. It contains information-packages for the end customers about:

- Market development
- Technique
- Planning of photovoltaics-systems
- Economics of photovoltaics-installations
- Components of a solar power plant
- Frequently asked questions

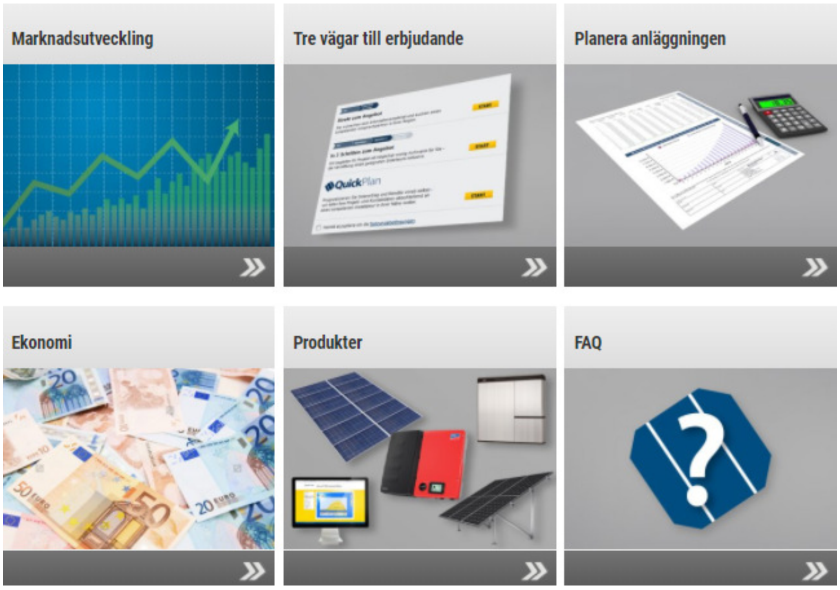


Figure 14: QuickContent-section - Package choice

The professional user can choose which parts of this toolbox he wants to integrate in his homepage. This includes the complete program *QuickPlan* as well. The content, that will appear on the users homepage can be designed in a layout that fits to the existing website.

7 Method

7.1 Preparation (only on request)

7.2 Share of work packages (only on request)

7.3 Time management (only on request)

7.4 Collecting contact information (only on request)

7.5 Conducting the interviews (only on request)

7.6 Documenting the results (only on request)

7.7 Analysing the results (only on request)

III Results

8 Statistic outcome

Within four weeks 35 companies have been visited and interviewed all over Sweden. In the meetings the interview-partners were shown the tools offered by EWS and asked 51 questions about their processes, habits and needs (The questionnaire can be seen in the appendix 16). The answers were documented and statistically registered in the attached Excel file “Complete statistic outcome of the interviews”. The most interesting, important and surprising outcome is presented in the following chapters.

Only answered questions were taken into the statistics in order to not falsify the results. This means, the sum of all given answers must not necessarily be 35.

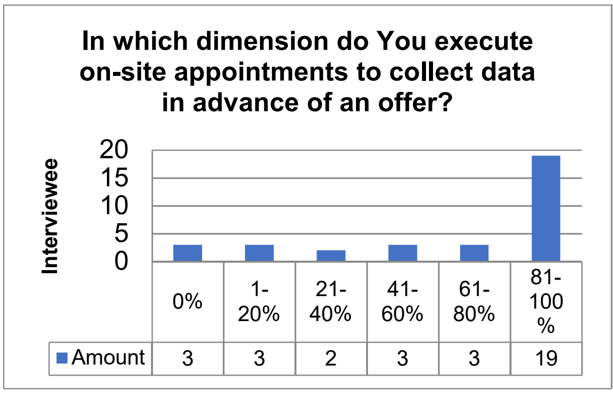
Numbers in brackets indicate the pictured graph in the appendix “Complete statistic outcome of the interviews”.

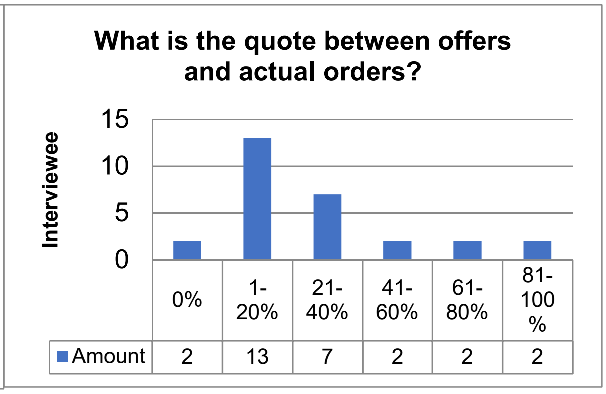
8.1 Interviewees

Of the 35 interviewed professionals 19 install PV-systems on their own, 15 sell solar components, 29 describe their function as consultants (0). All of them need to execute the planning of PV-installations in their daily work. The English-ability of the Swedish interviewees was reasonable to execute the interviews in English language mostly. Unexpectedly is the need for a planningtool in Swedish language not essential either (6).

8.2 The status quo

The ordinary way of gathering object-information and getting in contact with the end customer requires a lot of time and effort for on-site-visits (70 % in average) even before an offer can be made (32). Due to high competition and insecurity on the part of the end customers, the average quote between made offers and orders, the so-called hit-rate, is only 28 %, the majority even below 20 % (33).





Graph 2: Results question 32 and 33

This in combination means a big deal of time and effort which creates no sales volume.

The lion’s share of the projecting in Sweden is done with help of Excel-tools so far (13), which narrows the effort for keeping costs and product-data up to date (14).

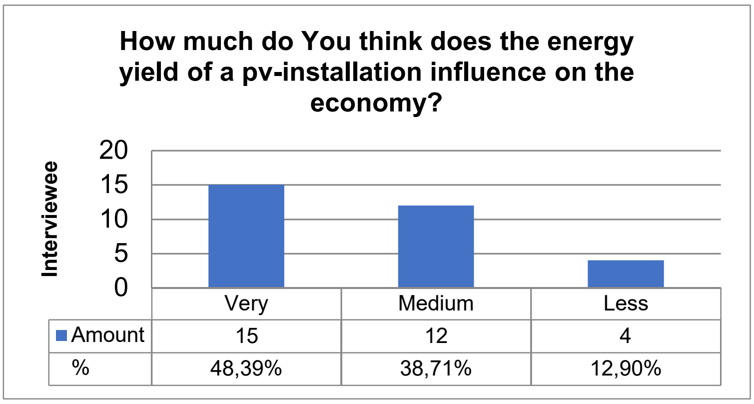
8.3 Characteristics of a perfect planningtool

Almost 4/5 of the asked professionals think it is important/very important, that a planningtool is online based (5). All of them suppose the handling to be essential (7).

94 % of the interviewees say, that the ability of a cost-calculation is essential in a planningtool (9), almost all of them wish to have at least a calculating-programme linked to the planningtool (16).

97 % deem it to be important/very important to take individual wishes of the customer, as well as special installation-conditions into consideration (8), because object-specific circumstances from their point of view have a huge impact on the cost of an installation (12). However, the majority of the Swedish users of planningtools seems to be unsure about the importance of sharing the project-documentation directly with the end customer so far (28). In the interviews 4/5 indicated, that it would be important to get recommendations regarding the cheapest combination of products in a planningtool (15).

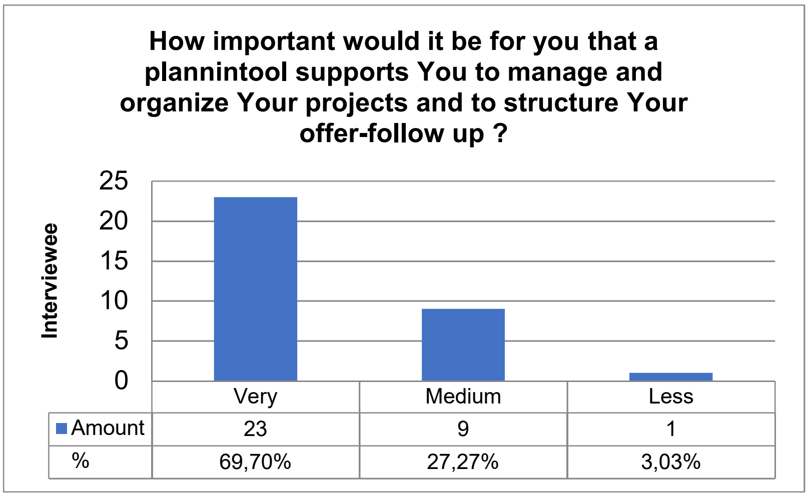
All of them think it is important to be able to calculate the energy yield within a planningtool, 85 % even indicate this to be crucial (17). All of them also say it is necessary to take the local climate data, the orientation respectively inclination of the modules and shadowing into consideration (18). More than half of the interview-partners miss the consideration of the Performance Ratio in their software-solution, nearly 85 % wish to have this (19), because even more (87 %) assume the energy yield to have a high impact on a PV-systems economy (20).



Graph 3: Results question 20

72 % of the interviewees deem it to be important to be able to calculate the economy of a PV-installation in a planningtool (21), more than 3/4 see the consideration of specific financing- and support factors as essential (22) and even more wish to get a prognosis of the return on investment (27).

The quote of self-consumption in combination with the electricity price is considered to be important or very important for 97 % of the interviewees (23) and 84 % of them wish to be able to adjust the future development of the electricity price individually (24). Even if the Swedish PV-market is not yet ready for measures like load-management, battery storages or e-mobility, more than 82 % of the consulted professionals deem the possibility of its consideration to be important/very important (26).



Graph 4: Results question 29

Almost all wish a function to manage and structure offers and the offer-tracking (29). Furthermore, it is important for 78 % of them to be supported in the communication with the end customer and their supplier (30) and 90 % want to have an access to the planningtool on their own homepage (31).

So far, less than 1/4 of the end customers get in contact via the homepage of a provider (34) and only slightly more of the remaining potential customers will enter a provider's homepage in order to collect information after the initial contact (35). Nevertheless, an own website with a more comprehensive offer of information is important/very important for 78 % of the interviewees (36). On the other hand, the future importance of printed information-material for advertisement is regarded with uncertainness (37).

Fewest of the interviewees buy leads from online tracing-services anymore, because more than 80 % consider its quote of success to be marginal (38). On the other hand, the implementation of multiplicators for the generation and prequalification of leads is seen positively (39) and more than 80 % would like to participate in such a structure (40).

8.4 The EWS-tools

The tools which are presented parallel to the interviews were rated predominantly positive (41-46). Among the proposals of advancements especially the implementation of Google Maps or a photo-realistic overlay for illustrating a systems layout was desired (48) and only few wished the consideration of leasing-options for solar systems (47).

9 Comments

Some of the frequently uttered comments emphasized the importance of findings, which are already illustrated in chapter 8 "Statistic outcome". One example is the recommendation not to use standardised system-packages or prices to avoid wrong calculations. Many indicated the importance of taking the load profile as well as the electricity price and its expected development over the next 20 years into consideration individually. Even more expressed the desire of combining every step of the project-calculation in one online tool in the nearest future.

Most of the interviewed professionals estimated a rising demand for information for the end customer on their homepages. Some even specified their expectation to get prepared white-label-solutions for this purpose, which are digitally connected with their planning tool. The latest technical product data and prices as well as subsidies and tax conditions should be given by the planning tool automatically, as many of the professional users mentioned.

Aside the already illustrated aspects, some other interesting comments were uttered. One example is, that some asked especially for real-time information about the availability of products in an online based cost-calculator and a track-and-trace feature to follow shipments. Another frequent comment was, that other solutions for the rooftop-mounting of modules are needed, due to special Swedish roof-constructions. Many interviewees considered the documentation of the pay-back time of the investment to be even more important than the return on invest for the Swedish end customers. According to several interview-partners, adding the ability to enter the size of the existing main-fuse and the number of phases in the net-connecting is essential. This is needed in common planning tools, to be aware of possible limitations of the size of a PV-system.

IV Recommendations

10 Consequences regarding the EWS-tools (only on request)

11 Further observations

11.1 Concrete descriptions and calculations (only on request)

11.2 Analysing the suitability of *QuickPlan* for multiplicators

To reinforce and channel the interest of private and commercial customers more effectively, cooperations with so-called multiplicators are recommendable. Potential multiplicators are all those companies, that do not have an own expertise in the PV-sector but are in a frequent contact with prospectives. In well-developed PV-markets like Germany, Denmark and France these are most often utility companies, building companies, energy consultants or financial institutions.

Using the experience and expertise gained in this thesis as a basis, it should be investigated how much the available tools support the implementation of multiplicators in the process of acquisition and informing and how the tools could be optimized for this purpose. The main focus of these investigations should be the ability of this software, to create a high rate of pre-qualifying and thereby a higher rate of success in the handling of customers. This could for example happen by an organized structuring of information and data. At the same time, an observation should happen, how far these so-called white-label-portals support the specific multiplicator to start up new business-models or at least to increase the customer loyalty.

In phone calls or personal meetings should be evaluated, how far such business-models are already established in the Swedish PV-market and which kind of experiences and expectations the interested multiplicator has. On the concrete example of *QuickPlan* the possibilities of planningtools for the acquisition and consultancy of interested end customers should be illustrated.

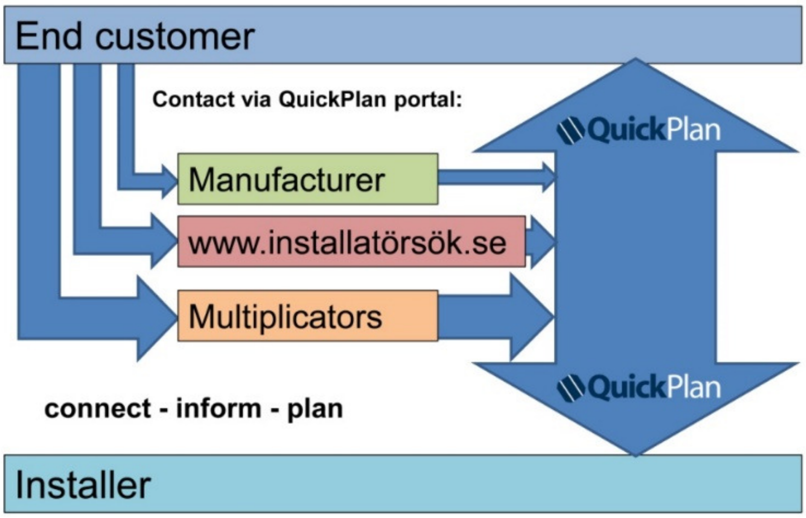


Figure 15: Organizational structure of the EWS business model

In a next step the interest amongst potential multiplicators for the business model of EWS should be investigated. The main focus of this model is the pre-qualification and mediation of end customer-contacts in return for a monetary provision (The detailed organizational structure can be seen in Figure 15). For this purpose, EWS already offers white-label-portals in Germany and Denmark, which mediate a major part of the prospects to the network of EWS-installer-partners. Beside the contacts, that are conveyed by manufacturers or the EWS end customer-portal www.installatörsök.se, an increasing number of prospects enter this network via *QuickPlan*-portals, that are integrated on homepages of multiplicators.

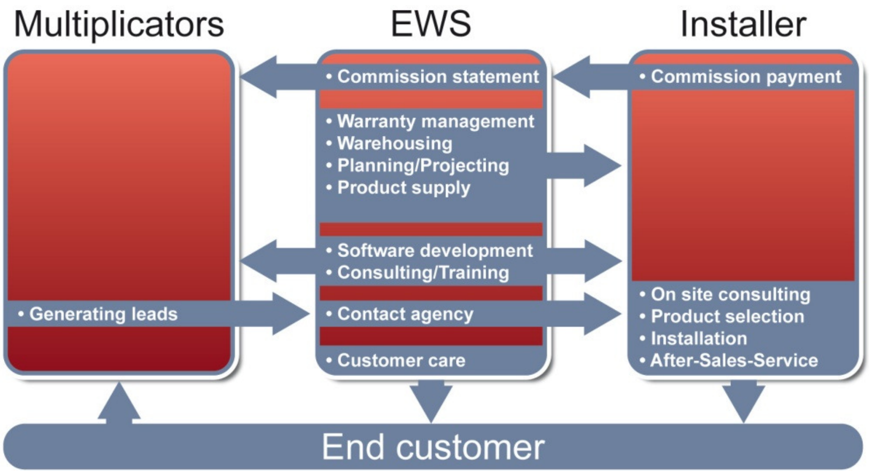


Figure 16: Task-sharing of the EWS business model

The business-model, offered by EWS for the multiplicators, bases on a task-sharing (shown in Figure 16), which concentrates on the competences and advantages of each participant. Based on the existing trust-basis, the multiplicators offer interested customers comprehensive information-material on their homepage and competent consultancy by a professional in their region. In the case of a successful mediation, the multiplicator gets a provision based on the value of the order.

V Summary

Most of the professional users of planningtools for PV-systems in Sweden wish to have an online based communication- and planningtool that optimally helps to organize and structure their sales activities and all processes of projecting. This is due to the increasing complexity of modern solar power plants and a lack of efficiency in the communication between customers, planners, solar installers and the distributors. These challenges are likely to increase as soon as the trend of improving a system's economic efficiency through higher levels of self-consumption (load management, electric mobility, storage systems) takes root in Sweden.

That is one of the results of this joint research with Lucas Lundberg of Mälardalens Högskola as well as with the support of the Glava Energy Center in Sweden and the German PV-distributor EWS. The objective of this work was to find out how to design a planningtool for the Swedish PV-market that is easy and intuitive to handle and, at the same time, detailed, comprehensive and precise enough to facilitate the planning and installation process while delivering reliable results.

For this purpose, 35 solar installers and consultants were interviewed about their demands and expectations concerning an optimal software solution. The findings were analysed and summed up. A majority of them stated that the desired online tool should be user friendly, so that they can share the project's process with their customers in real time via a white-Label- Version integrated on their homepage. A major requirement in such a tool is that it combines the technical planning directly with a calculator for the costs, the energy yield and the economic results. Almost all of the interview partners expect features for monitoring the rate of self-consumption and the development of the electricity price to become more and more important in a planningtool. Therefore, more than 80 % of the interviewees desire to be able to individually adjust the possibility of measures for load management (like a heat pump, an electric vehicle or a stationary battery storage). 97 % of the PV-professionals indicate that the tool should include a function, which helps them with the follow-up of orders and the customer-communication.

All interview partners share a positive expectation for the development of the PV-market in Sweden. The political decision of phasing out nuclear power in the medium term increases the pressure of extending renewable energies in Sweden, if the set climate-goals are to be kept. Today, renewable energies cover more than 50 % of the country's electricity demand and the goal of the official energy agreement is, to increase that up to 100 % in year 2040. If the projected solar potential of more than 30 GWp was to be tapped, a PV capacity that is a hundred times bigger than the current figure of 0.3 GWp would be to be installed in Sweden.

As soon as the ecological and economic advantages of decentralized grid-connected PV systems have become known to a wider public in Sweden, thus resulting in a rising demand, the solar installers will face huge challenges in the field of marketing and designing individual planned installations. Therefore, a digital approach to sales and distribution will be essential in order to optimize all processes. However, the prominence of the communication quality between all parties that are involved in a PV-project will increase rapidly parallel to the pressure on the quality of all planning and realizing processes. Customers will expect an even shorter reaction time and more attractive offers from the providers, while those have to handle an increasingly complex supply side. The focus of these investigations was to develop a software which helps the professional users to generate more and more pre-qualified customer leads.

VI Appendix

12 Bibliography (only on request)

13 List of abbreviations (only on request)

14 Table of quota for electricity certificates (only on request)

15 Project-summary established in QuickPlan

Thesis-project
Testgata 1
41101 Göteborg

Din projektskiss

17. februari 2018

Anläggningsstorlek: 11,88 kWp (reell moduleffekt)

Hej

denna dokumentation ger dig ett första intryck av möjligheterna med solceller på ditt tak.

Dokumentationen skapades med QuickPlan, kommunikationsplattformen för solcellsprojekt, och baserar sig på den specifika information som du angivit. **Notera att projektskissen inte ersätter en professionell projektering av ditt solcellssystem ty en sådan kräver att en fackman går igenom objektdata och eventuella avgränsningar.** En bindande offert kan sedan tas fram efter inspektion på plats.

Genom kommunikationsplattformen i QuickPlan kan vi dock hela tiden online gemensamt jämföra olika varianter av ditt projekt.

Med hjälp av QuickPlan kan vi gemensamt analysera vilka effekter olika anläggningsparametrar och din egenförbrukning har på ekonomin för ditt solcellssystem. Dessutom finner du alternativ på hur du kan öka egenförbrukningen och på så sätt även öka avkastningen på investerat kapital.

Vi hjälper dig gärna vidare med ditt projekt och finns alltid tillgängliga för en personlig handläggning.

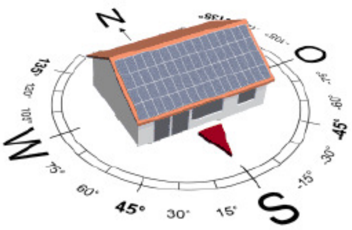
Med vänliga hälsningar

Din solpartner

Detts system planerades med komponenter från:

1

OBJEKTDATA	AVKASTNINGSPROGNOS	EKONOMI	GRAFIK	KOSTNAD



OBJEKTDATA

Objekttyp	Enfamiljshus
Takform	Sadeltak
Typ av byggprojekt	Nybyggnation
Ytlängd	12 m
Ytbredd	7 m
Spärrytor	2 m²
Tillgänglig takyta	82 m²
Tak- och uppställningsvinkel	30 °
Sydavvikelse	0 °
Skuggning	nej
Uppställning	Ingen uppställning
Takunderkonstruktion	Sparrtak
Material underkonstruktion	Träkonstruktion: massivt trä
Beläggning	Takpannor
Takinfästning med hjälp av	Takkrokar
Projektspecifikation	Högsta möjliga avkastning
Ställningsläggning	1-lagerssystem
Modulanordning	Ingen preferens
Växelriktarplats	inomhus

Förväntad anläggningsstorlek **11,88 kWp**
(enl. beräkning av installatör)

Detts system planerades med komponenter från:

Trinasolar Smart Energy Together | Fronius SHIFTING THE LIMITS | ALTEC Metalltechnik

2

OBJEKTDATA	AVKASTNINGSPROGNOS	EKONOMI	GRAFIK	KOSTNAD

AVKASTNINGSPROGNOS

Anläggningsort	41101 Göteborg
Förväntad anläggningsstorlek totalt	11,88 kWp *(enl. beräkning av installatör)*
Performance Ratio	0,84
planerad idrifttagning	2018
Arlig säkerhetsmarginal	0,25 %

Spec. årlig elproduktion	**1.021,6 kWh/kWp/a**

årlig elproduktion	12.136,61 kWh
Elproduktion över 20 år	237.049 kWh

Detts system planerades med komponenter från:

OBJEKTDATA	AVKASTNINGSPROGNOS	EKONOMI	GRAFIK	KOSTNAD

EKONOMISK BERÄKNING

KOSTNAD/FINANSIERING*

Anläggningskostnad*	136.550 SEK
ytterl. engångskostn. Omsättning laststyrning*	2850 SEK
Totalkostnad*	164.536 SEK
Kostnad/kWp*	13.017 SEK

Andel egenkapital* **38.662 SEK (25 %)**

att finansiera*	115.985 SEK
Räntesats	2 %
betalningsfria år	1 År
Löptid	20 År
Överbryggande finansiering	Låneränta: 6 %, Kreditränta: 2 %, Bankränta: 3 %
Reserv underhåll	1,0 % av anläggningskost.
Kostnad försäkring	0,7 % av anläggningskost.

** icke-bindande uppskattning*

EGENFÖRBRUKNING

Användningstyp	privat
direkt egenförbrukning	4.683,52 kWh/År
ytterl. elbil m. laststyrning	558,28 kWh/År
ytterl. elbil genom batteri	493,67 kWh/År
Tot. egenförbrukning genom e-mobilitet	2.367,67 kWh/År
Egenförbrukning totalt	8.103,15 kWh/År

Egenförbrukningskvot **66,78 %**

Kvot bestämd genom	Lastprofil "Hushåll med större lastsvängningar"
eff. elpris vid drifttagande	1,35 Öre/kWh
årlig stigning elpris	DYNAMISK

Detts system planerades med komponenter från:

4

OBJEKTDATA	AVKASTNINGSPROGNOS	EKONOMI	GRAFIK	KOSTNAD

LAGRINGSLÖSNING

Lagringskapacitet	5 kWh
Verkningsgrad	90 %
Eff. lagringskapacitet	4,5 kWh
Batteri-inv.stöd	9890 SEK

E-MOBILITET

Daglig körsträcka	100 km
Lagringskapacitet bilbatteri	20 kWh
Laddeffekt hos laddstation	3 kW

SAMMANFATTNING EKONOMI

Ditt solcellssystem ger under en livstid på 20 år ca.	**166.385 SEK**
Med den angivna egenkapitalandelen blir den förväntade genomsnittliga årliga avkastningen på investerat kapital	**7,24 %**

ÅRLIG AVKASTNING

År	Avkastning från solcellssystemet			Reserv underhåll/ Lagring	Kostnad försäkr.	Ytterl. årl. kostn.	Ränta & återbetaln.	Ränta på ackum. avkast. fr. föreg. år	Års-avkastning	Ackumulerad avkastning
	Inmatningstariff	Elpris-besp. genom egenförbr.	Skattereduktion							
1	1.607 SEK	11.056 SEK	2.386 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-2.270 SEK	0 SEK	9.982 SEK	**9.982 SEK**
2	1.636 SEK	11.099 SEK	2.402 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-8.245 SEK	200 SEK	4.296 SEK	**14.278 SEK**
3	1.651 SEK	11.199 SEK	2.396 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-8.125 SEK	286 SEK	4.609 SEK	**18.887 SEK**
4	1.666 SEK	11.305 SEK	2.390 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-8.006 SEK	378 SEK	4.937 SEK	**23.824 SEK**
5	1.683 SEK	11.418 SEK	2.384 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-7.886 SEK	476 SEK	5.278 SEK	**29.102 SEK**
6	1.701 SEK	11.537 SEK	2.378 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-7.767 SEK	582 SEK	5.634 SEK	**34.736 SEK**
7	1.719 SEK	11.664 SEK	2.372 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-7.647 SEK	695 SEK	6.006 SEK	**40.742 SEK**
8	1.739 SEK	11.798 SEK	2.366 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-7.528 SEK	815 SEK	6.393 SEK	**47.135 SEK**
9	1.760 SEK	11.939 SEK	2.360 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-7.408 SEK	943 SEK	6.796 SEK	**53.931 SEK**
10	1.782 SEK	12.087 SEK	2.354 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-7.289 SEK	1.079 SEK	7.216 SEK	**61.147 SEK**
11	1.803 SEK	12.232 SEK	2.349 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-7.169 SEK	1.223 SEK	7.640 SEK	**68.787 SEK**
12	1.824 SEK	12.372 SEK	2.343 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-7.050 SEK	1.376 SEK	8.068 SEK	**76.855 SEK**
13	1.844 SEK	12.508 SEK	2.337 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-6.930 SEK	1.537 SEK	8.498 SEK	**85.353 SEK**
14	1.863 SEK	12.639 SEK	2.331 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-6.811 SEK	1.707 SEK	8.932 SEK	**94.285 SEK**
15	1.881 SEK	12.765 SEK	2.325 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-6.691 SEK	1.886 SEK	9.369 SEK	**103.654 SEK**
16	1.899 SEK	12.886 SEK	2.319 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-6.572 SEK	2.073 SEK	9.809 SEK	**113.463 SEK**
17	1.916 SEK	13.001 SEK	2.314 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-6.452 SEK	2.269 SEK	10.251 SEK	**123.714 SEK**
18	1.933 SEK	13.112 SEK	2.308 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-6.333 SEK	2.474 SEK	10.696 SEK	**134.410 SEK**
19	1.948 SEK	13.216 SEK	2.302 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-6.213 SEK	2.688 SEK	11.144 SEK	**145.554 SEK**
20	1.963 SEK	13.315 SEK	2.296 SEK	-1.645 SEK	-1.152 SEK	0 SEK	-119 SEK	2.911 SEK	17.568 SEK	**166.385 SEK**

Ditt solcellssystem ger en vinst på 166.385 SEK under 20 år.

Detts system planerades med komponenter från:

OBJEKTDATA	AVKASTNINGSPROGNOS	EKONOMI	GRAFIK	KOSTNAD

JÄMFÖRELSE MED GENOMSNITTLIG BANKINVESTERING

Antaganden:

Egenkapital:	41.134 SEK
Bankränta:	3,00 %
Löptid:	20

År	Vinst med bankränta på 3 %	Vinst på egenkapitalandel från egenkapitalandel
0	1.234 SEK	0 SEK
1	2.505 SEK	-31.152 SEK
2	3.814 SEK	-26.856 SEK
3	5.163 SEK	-22.247 SEK
4	6.552 SEK	-17.310 SEK
5	7.982 SEK	-12.032 SEK
6	9.456 SEK	-6.398 SEK
7	10.973 SEK	-392 SEK
8	12.537 SEK	6.001 SEK
9	14.147 SEK	12.797 SEK
10	15.805 SEK	20.013 SEK
11	17.513 SEK	27.653 SEK
12	19.273 SEK	35.721 SEK
13	21.085 SEK	44.219 SEK
14	22.951 SEK	53.151 SEK
15	24.874 SEK	62.520 SEK
16	26.854 SEK	72.329 SEK
17	28.894 SEK	82.580 SEK
18	30.995 SEK	93.276 SEK
19	33.159 SEK	104.420 SEK
20	35.387 SEK	125.251 SEK

Ditt solcellssystem ger 89.864 SEK mer än en genomsnittlig bankinvestering.

Detts system planerades med komponenter från:

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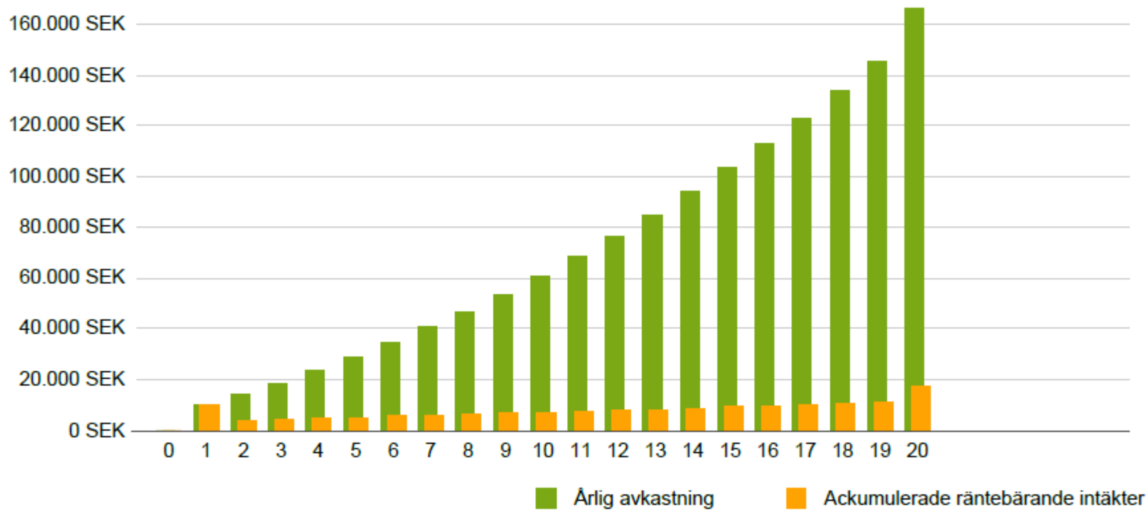
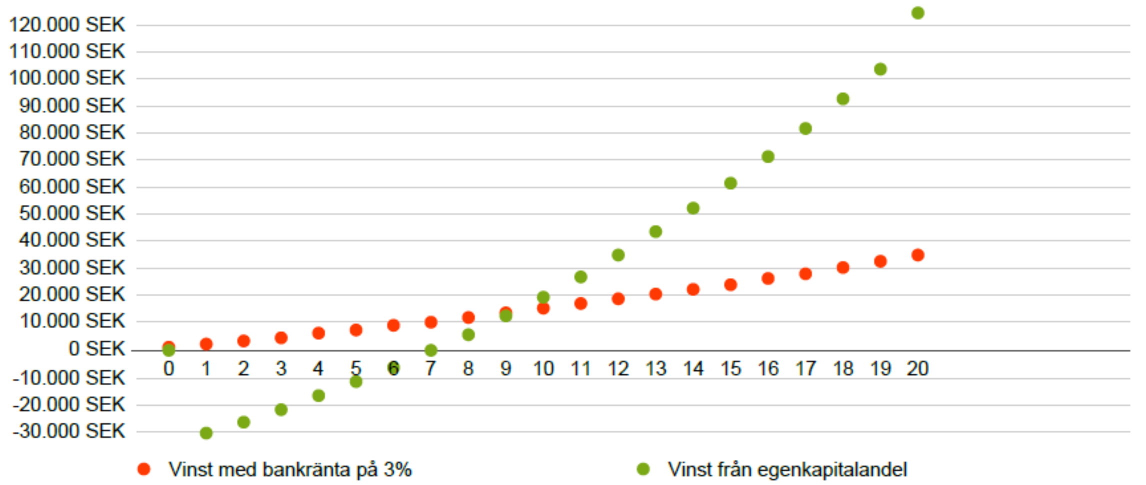
OBJEKTDATA	AVKASTNINGSPROGNOS	EKONOMI	GRAFIK	KOSTNAD

GRAFISK UTVäRDERING



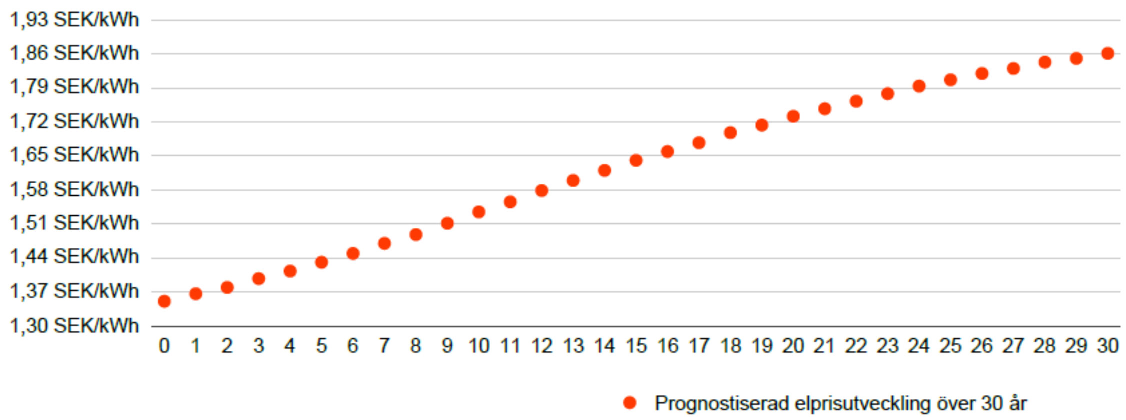


Vid en egenkapitalandel på 25,00 % blir avkastning på investerat kapital 7,24 % p. a.

Detts system planerades med komponenter från:

OBJEKTDATA	AVKASTNINGSPROGNOS	EKONOMI	GRAFIK	KOSTNAD

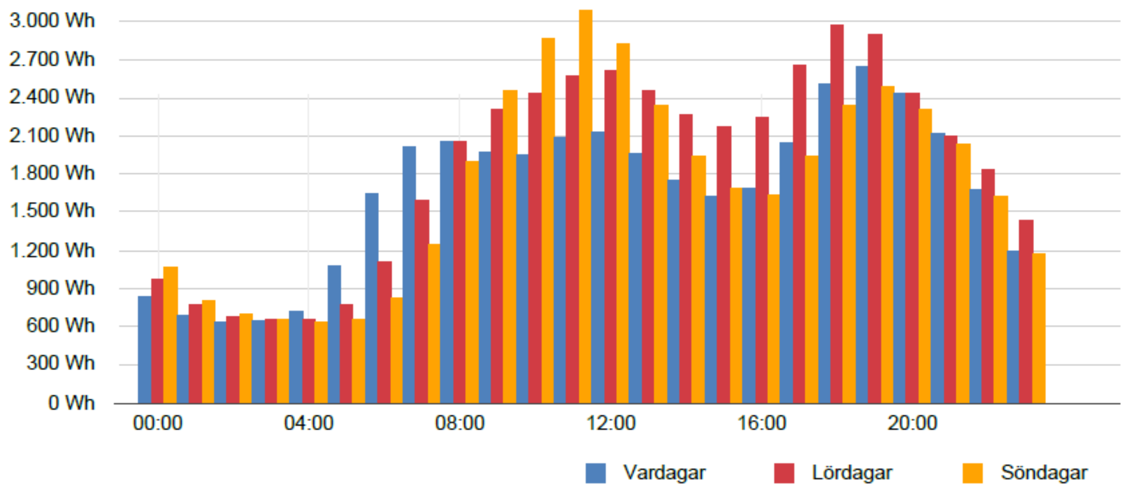
ELPRISUTVECKLING



LASTPROFIL

Lastprofil: "Hushåll med större lastsvängningar"

Ø Elförbrukning över dagen



Detts system planerades med komponenter från:

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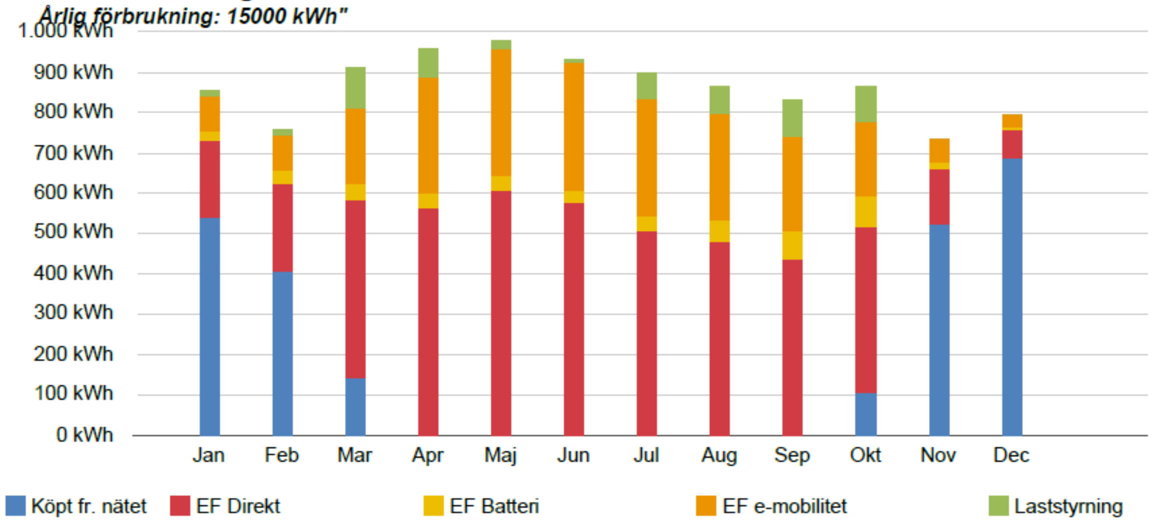
OBJEKTDATA	AVKASTNINGSPROGNOS	EKONOMI	GRAFIK	KOSTNAD

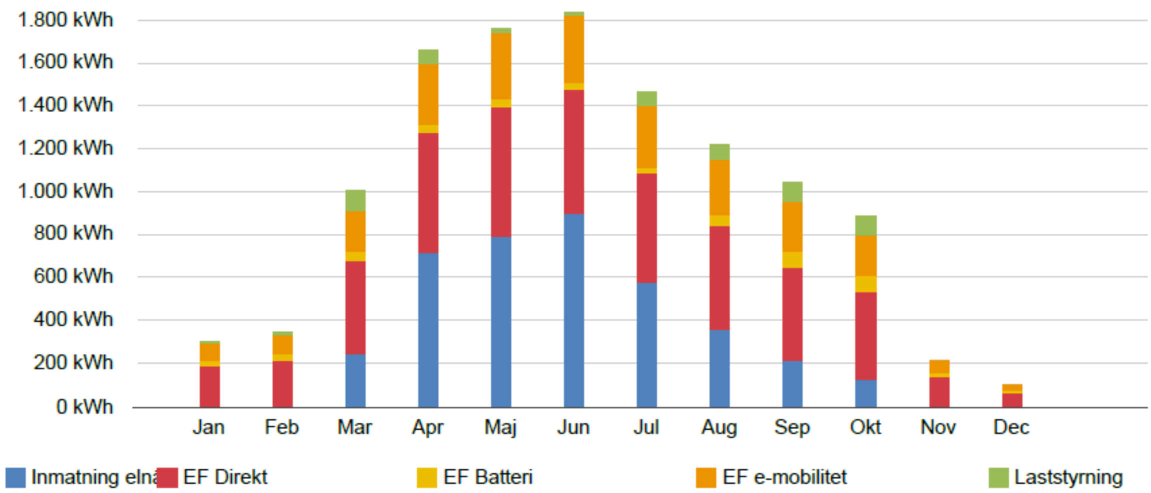
Ø Elförbrukning över året

Årlig förbrukning: 15000 kWh"



Solelgenerering över året

Årlig avkastning: 12136,608 kWh"



Detts system planerades med komponenter från:

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OBJEKTDATA	AVKASTNINGSPROGNOS	EKONOMI	GRAFIK	KOSTNAD

Green Energy

Icke-bindande kostnadsberäkning

Byggprojekt:

Anläggningsstorlek: 11,88 kWp (reell moduleffekt) **17. februari 2018**

Antal	Poster	Totalpris netto
44 St.	Trina - TSM-PD05, 270Wp, poly	**48.661,51 SEK**
1 St.	Fronius - Symo 12.5-3-M Light	**17.720,71 SEK**
		Totaleffekt växelriktare: 12,5 kWp
1 st.	Fronius Symo Hybrid 5.0-3-S	**18.955,06 SEK**

Ert montageval: ALTEC - Takkrok

110 St.	Takkrok Standard-basplatta 180x80	7.140,10 SEK
222 St.	Flat head-skruv	819,18 SEK
110 St.	Skruv Hammarhuvud	234,30 SEK
35 St.	Slutklammer	203,70 SEK
69 St.	Mellanklammer	425,73 SEK
21 St.	Cylindertoppskruv	22,26 SEK
35 St.	Ändlock för profil	44,80 SEK
96 m	DC-profilskena	3.323,52 SEK
	Summa montage:	**12.213,59 SEK**

Påslag fraktkostnad:	**4.000,00 SEK**
Påslag elektronik (kabel & kontakter) / nätanslutning / övrigt:	**5.000,00 SEK**
Påslag montage:	**30.000,00 SEK**

Summa kostnadsberäkning (netto)	**136.550,43 SEK**
25% Moms:	34.137,61 SEK
Summa kostnadsberäkning (brutto)	**170.688,04 SEK**

Detts system planerades med komponenter från:

Trinasolar Smart Energy Together · Fronius SHIFTING THE LIMITS · ALTEC Metalltechnik

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16 Questionnaire for the interviews (only on request)

17 Complete statistic outcome of the interviews (only on request)

Due to reasons of confidentiality, the individual results of each interview cannot be shown in this thesis.