Chapter 12
Methodology of Solar Project Managing Through All Stages of Development

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Abstract The unique methodology for managing solar projects through all of their development stages has been created. This paper provides detailed description of the specifics of this methodology and describes its benefits and necessity. The lack of a unified methodology is caused by the fact that there are many service providers, which offer various separate tools and services for solar energy companies. Most of the available separate services and tools focus on supporting a specific stage of solar project development. Overall, the lack of a unified methodology leads to unnecessary resource spending, making the final costs of solar projects higher, and lengthening payback time, thus making solar energy less attractive. Developed methodology is the result of cooperation between solar installers, solar software developers, and researchers. In the process of methodology development, the unique knowledge transfer space was created. This allowed to pinpoint the real needs of a solar energy project development process and discover the solutions to the burning issues. The developed methodology is represented as the service platform PVStream, and its services cover the full scope of the needs of solar energy project development. The tools and services united by the methodology include a lead generation and proposal tool, financial feasibility analysis, energy efficiency analysis, project design and engineering tool, performance modeling and simulation suite, and monitoring and maintenance tool. The usage of such methodology significantly reduces human resources time by automating design, performance modeling, documentation creation, and overall project management. Further development and dissemination of the united solar energy project development methodology will make solar energy more affordable and attractive, by cutting the costs of the project development and cutting overhead costs of solar energy companies.

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A. Sayigh (ed.), *Sustainable Building for a Cleaner Environment*,
Innovative Renewable Energy, https://doi.org/10.1007/978-3-319-94595-8_12

12.1 Introduction

The solar photovoltaic (PV) energy share in the overall European energy production amounted for 12% [1] of all renewable electricity in Europe. The considerable growth of this sector has been driven by the technological advances that led to the reduction of costs [2–4]. Since the technology costs have been dropping [5–7], it is quite important to provide the needed infrastructure to empower solar industry companies to reduce administrative costs.

Photovoltaic (PV), solar heating, and cooling projects require significant initial investments to set up a solar energy system [8] and substantial time for this investment to pay off. Precise calculations and simulations are essential for the solar energy system development process at each stage to provide an optimal system for the needs of the end user.

It is important to keep the administrative costs low to keep raising the attractiveness of solar energy for the consumer [9]. The easy-to-use infrastructure that facilitates development of links between potential customers and existing service providers is needed for further development of the solar energy industry. Such networking space will help to bring solar energy closer to the general public and facilitate the process of the transition from fossil fuels to the renewable energy sources.

Lack of a unified format and unified tool set for photovoltaic, solar heating, and cooling projects management hinders the development of cross-border cooperation [10]. Having a unified methodology for calculations and simulations of the performance of solar energy projects that is flexible enough to include all the necessary parameters into consideration would significantly simplify the financing and investment decisions for general public, financial institutions, and political institutions. PVStream methodology reduces the amounts of time and resources necessary for solar energy project development and support.

12.2 Methodology

PVStream methodology development required input from groups and people of various backgrounds. The methodology was developed as a collaboration between researchers (Latvian Institute of physical energetics, Latvia Energy Institute), practitioners in the industry (among them), developers of solar energy simulation algorithms (Sandia, NREL SAM) and various mathematical models (wind load, shading), and experienced software developers for the solar energy industry (S Fabrika).

Development of the methodology included the following: examination of the results of multiple research projects in the field of solar energy and renewable energy, study of the current solar energy project development process, discussion boards regarding the most common pain points from the companies in the industry, surveys and polls of the solar energy company representatives and solar energy users, study of the tools and services that are available for the solar energy companies on the global market, development and testing of the mathematical models, and algorithms for calculations and simulations.

The information received from universities, researchers, and industry representatives become the basis of this methodology. The result of the analysis was a set of specific rules and guidelines and a set of various calculation models and algorithms. These results already were critically examined and reviewed during common meetings with partners.

12.3 Results and Discussions

The major idea we put in the PVStream methodology is to organize and streamline the photovoltaic, solar heating, and cooling project development process by providing guidelines, algorithms, and calculation models on every stage of development and support process. These guidelines, models, and algorithms together with an overall development and support process have been implemented practically in PVStream service platform.

Over the duration of its development, every solar energy project goes through specific development stages: proposal, design, installation, and support (Fig. 12.1).

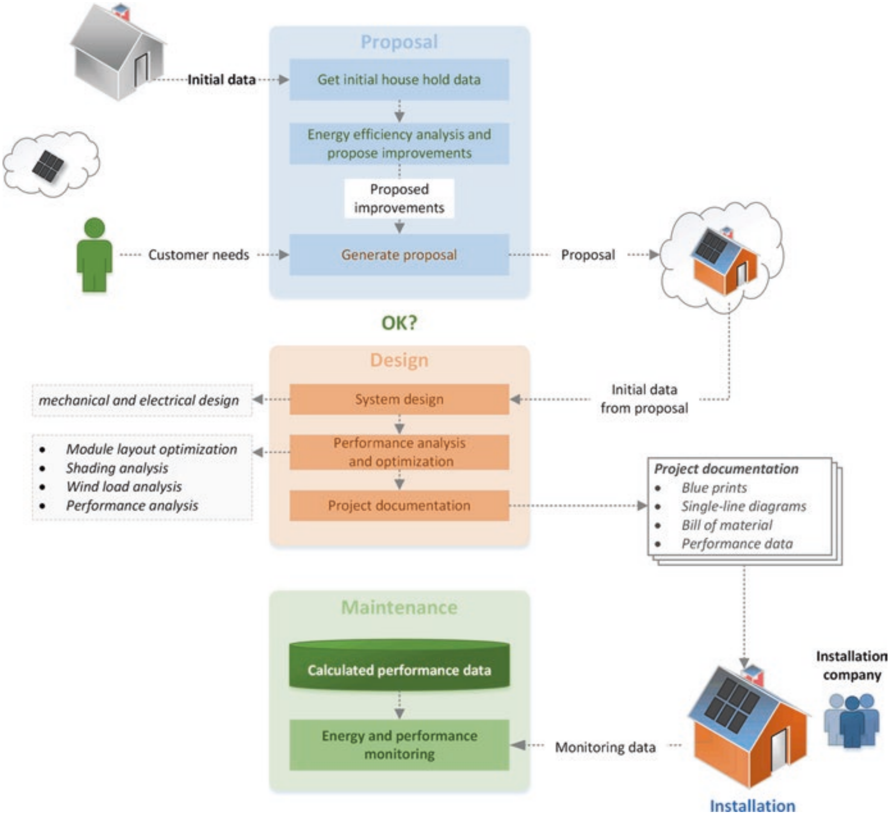
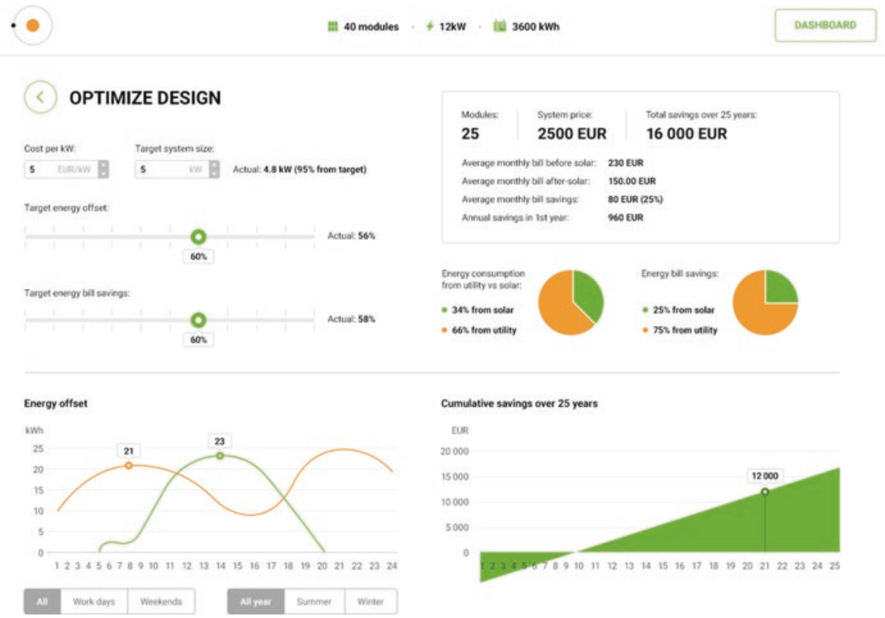


Fig. 12.1 PVStream methodology project life cycle


40 modules · 12kW · 3600 kWh

OPTIMIZE DESIGN

Cost per kW: 5 EUR/kW

Target system size: 5 kW Actual: 4.8 kW (95% from target)

Target energy offset: 60% Actual: 56%

Target energy bill savings: 60% Actual: 58%

Modules: 25

System price: 2500 EUR

Total savings over 25 years: 16 000 EUR

Average monthly bill before solar: 230 EUR

Average monthly bill after-solar: 150.00 EUR

Average monthly bill savings: 80 EUR (25%)

Annual savings in 1st year: 960 EUR

Energy consumption from utility vs solar:
- 34% from solar
- 66% from utility

Energy bill savings:
- 25% from solar
- 75% from utility

Fig. 12.2 Optimization possibilities and its influence on system results

The proposal stage begins with the initial contact with the potential customer and ends up with the defined goals of a solar project, chosen financing and investment model, and preliminary engineering design of the future project.

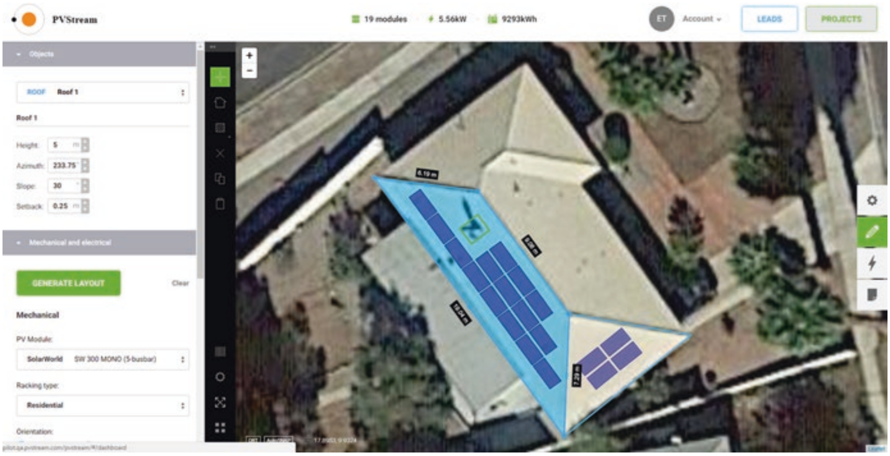
At the design stage, engineering and electrical design take place. This stage results in the finalized full project documentation for the installation team.

During Installation stage, physical installation of solar energy system is performed. Over the maintenance and support stages, further support of the installed solar energy system happens.

The developed solar project management methodology defines overall project management process and specific rules, regulations, and practices which apply to a particular life cycle stage. As practical implementation to proposed methodology software service platform PVStream has been developed (Fig. 12.2).

General rules apply to the overall project management process and are not focusing on a particular project life cycle stage.

It is beneficial to use a minimal number of tools for the project management process. Whenever multiple tools are used, the integration needs to be performed to transfer results and information from one tool to another; this forces spending additional time (up to 2 weeks per project) and resources and raises administrative costs. One of the ways to avoid these unnecessary costs is to use all-in-one solutions that lead the solar energy project development throughout all development stages within the scope of one tool.



ROOF Roof 1

Roof 1

Height: 5 m

Azimuth: 233.75°

Slope: 30°

Setback: 0.25 m

PV Module: SolarWorld SW 300 MONO (5-busbar)

Racking type: Residential

Fig. 12.3 Capture roof data from satellite image

It is beneficial to avoid initial on-site visits. Elimination of the necessity of initial on-site visits allows to decrease administrative costs and to focus on the solar energy project development. PVStream methodology allows to utilize various sources for initial data capturing, starting from specifically dedicated services, such as Eagleview, to satellite images, including Google Maps (see Fig. 12.3).

Methodology allows to run project optimization, according to the customer's needs at the earliest stages of solar project development (Fig. 12.4). PVStream provides rules and guidelines on calculations for the optimal solar energy project for the instances when the customer aims to decrease the energy bill to a specific amount, when the customer wants to receive 100% of consumed energy from solar energy, or when the customer wants to invest specific sum to the renewable energy development. PVStream methodology contains a set of algorithms and actions that allow to meet the actual customer's goals during project development and keep the customer at the center of the project. Figure 12.5 shows part of financial analysis results presented to the customer.

Exploration of available financial support options, such as government incentives, rebates, feed in savings tariffs, etc., into the initial financial analysis of the planned solar energy project is necessary. This makes the benefits of transition to solar energy obvious to the end user. Services that provide information for a specific limited set of regions exist at the moment. In order to be able to provide Europeans with the accurate data, PVStream collects and aggregates data about the available support for solar energy projects, according to the region where the planned project is to be installed.

According to PVStream methodology, the engineering and design team continues project development, utilizing as much data as possible from the proposal stage. This includes roof and obstruction drawings, information about nearby objects that might influence solar system performance like trees and other roofs, energy

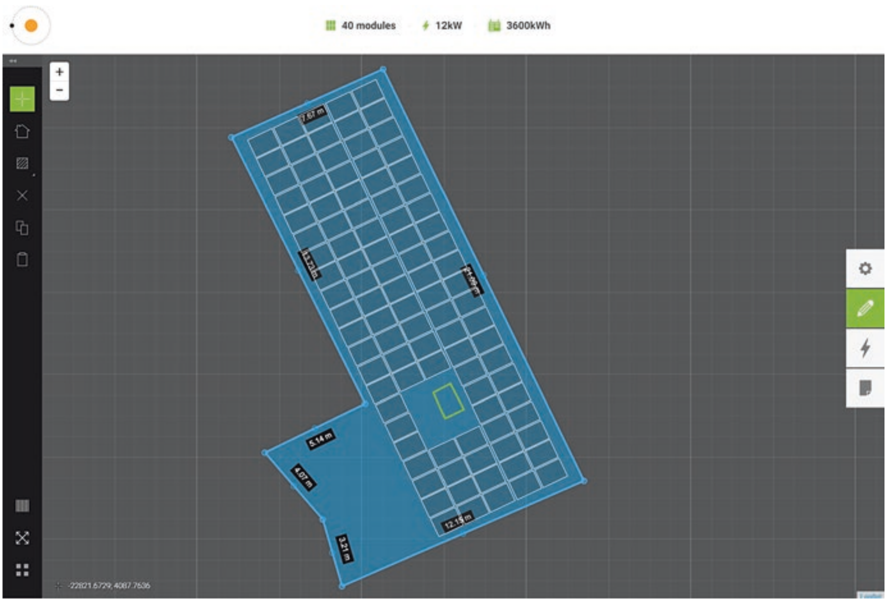


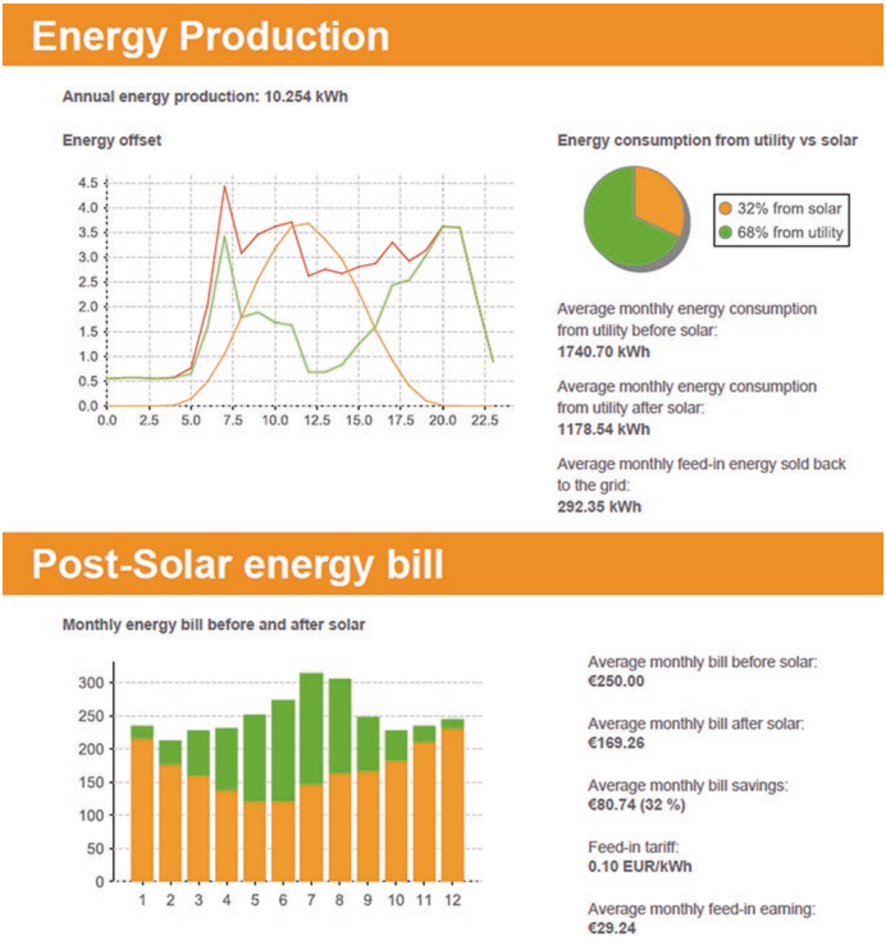
Fig. 12.4 Designer view – mechanical design stage

consumption before solar project installation expenses, and the customer's aims. This significantly reduces the time to set up a design project. Using the initial data collected at the proposal stage for the automated design process can reduce the costs for the solar energy project development up to 75%.

The design of a solar energy project must include a set of specific analyses. In order to avoid large discrepancies between the real performance of the system and the forecasted performance, it is essential to run full-scale shading analysis. PVStream methodology provides several shading algorithms, such as shadow pie to calculate the area in which specific objects cast shadows, ray tracing to run simulation for every hour within the entire year, and PV module self-shading calculation algorithms. These algorithms allow to estimate energy production for each individual PV module accurately.

Wind load and roof load algorithms are essential parts of the design process. Since the results of these calculations define the amount of ballast, inaccurate calculations lead to an inaccurate and nonoptimal bill of material which results in extra costs. The developed algorithms and methods for wind load calculation include various parameters, among them roof data and shape, objects located on the roof, the location of every PV module, type of roof cover, and of course climate data. This makes calculations much more accurate and results in the projection of a safe system with a more optimal bill of materials.

In the cases when any changes have been made in the project blueprints or calculations during the installation stage, the project should return to the design stage. This is needed in order to incorporate all the amendments, run additional simula-



Energy Production

Annual energy production: 10.254 kWh

Energy offset

Energy consumption from utility vs solar

● 32% from solar
● 68% from utility

Average monthly energy consumption from utility before solar:
1740.70 kWh

Average monthly energy consumption from utility after solar:
1178.54 kWh

Average monthly feed-in energy sold back to the grid:
292.35 kWh

Post-Solar energy bill

Monthly energy bill before and after solar

Average monthly bill before solar:
€250.00

Average monthly bill after solar:
€169.26

Average monthly bill savings:
€80.74 (32 %)

Feed-in tariff:
0.10 EUR/kWh

Average monthly feed-in earning:
€29.24

Fig. 12.5 Example of results of cost-efficient analysis

tions, and ensure that the impact of the amendments to the initial design on the overall system performance is reflected and recorded in the project documentation. This allows to avoid any extra costs that might be caused by the amendments to the initial design.

Include monitoring of the actual system performance into the support of the solar energy process to provide continuous data acquisition and aggregation from the installed system on each individual system node. Using continuous analysis of actual data and comparing it with simulated data, it is possible to predict malfunctioning on different system nodes. Detecting a fault before it really occurs allows to fix the issue before it has an impact on the overall system performance, thus increasing the reliability of the system. PVStream methodology includes smart prediction logic which can detect faults by comparing actual system performance with forecast.

The web-based platform PVStream has been developed that incorporates most of the above-mentioned rules, recommendations, algorithms, and calculations. This set of tools covers all stages of the solar energy project's development and is flexible enough for further developments.

Development of PVStream methodology has both direct and indirect benefits. It widens the set of available tools for all the parties involved in the development of the solar energy industry: researchers, end users, solar energy companies, and regulatory institutions. The methodology also facilitates the development of cross-border and cross-sector collaboration and contributes to the development of a unified regional standard for solar energy project management.

12.4 Conclusions

The practical usage of the methodology using PVStream web-based platform showed that accepting the above-mentioned rules saves time and resources.

Minimizing the number of different tools used saves up to 2 weeks spent on data integration, and the usage of web-based software tools minimizes the number of possible errors and saves additional amounts of time.

Ability to focus most of the efforts on the actual client allows solar industry companies to cut the resources and time spent on the initial on-site visits by up to 95%.

By using PVStream financial analysis models, the sales team can save up to 80% of time on financial analysis and proposals generation.

Streamlining and automating design process, by following PVStream guidelines and using proposed simulation and calculation models, decreases the overall design cost by an additional 75%.

According to PVStream methodology, continuous monitoring of system performance on the individual node level is a must-have option. Together with continuous comparison with predicted data, this allows to detect failures earlier, thus avoiding costly repairs and extending the installed system life time.

Overall, accepting the rules developed within the scope of the methodology and using appropriate tools allow to save up to 70% of time and resources spent within the solar energy project development. This can help keep administrative costs low and contribute to the transition from fossil fuel to renewable energy sources.

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