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Diploma Thesis Abstract

**Analysis of the Return on Investment in Photovoltaics in
Selected EU Countries**

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Summary

The Thesis provides an analysis of attractiveness of investment in large-scale photovoltaic installations in Germany and France. After discussing theoretical background of economy of photovoltaic technology, of renewable energy policy tools and of types of financing of solar businesses, a thorough study of relevant pieces of both national and supranational legislation follows. Types of existing support and their implications are examined alongside with an analysis of appropriate business structures and tax consequences.

A financial model of a photovoltaic power plant is then developed for each of the countries, based on findings from the study of legislation and literature review. This model contains a wide range of controllable input parameters including type of financing of the project. It is slightly modified for each of the countries in order to be adjusted for the most advantageous business structure available for the given type of project. Based on the model output, solar projects in both countries are evaluated using methods of capital budgeting.

Results of the analysis suggest that large-scale photovoltaic facilities do not achieve satisfactory internal rate of return under existing legislation in neither of the countries. Especially the model facility in Germany has not proved to be profitable, unless major adjustments of the input variables are made. However, in France, findings suggest that the project should be undertaken when using equity finance and a low internal rate of return, or when benefiting from a low-interest debt. Final recommendations discuss implications of the research for investors, policymakers and photovoltaic supply chain.

Keywords

photovoltaics, photovoltaics in the EU, regulation of photovoltaics, regulatory policy, renewable energy sources policy, investment in photovoltaics

Objectives of the Thesis

The objective of this Thesis is to analyse attractiveness of investment in photovoltaic (PV) installations in the context of legislation of two major EU markets: Germany and France. The Thesis seeks to conduct this analysis while taking into regard legislative implications of each of the markets, as well as a way of financing of the project and a range of specific parameters of the power plants.

An integral part of the objectives therefore is to provide a detailed summary of relevant pieces of recent **legislation** of each of the countries and of the EU. The analysis

consequently focuses on an overview of renewable energy (RE) policy and its outlook in the given country. Subsequently, types of support for electricity from RE sources (RES) are examined with an emphasis on implications for solar businesses. Last but not least, business structures appropriate for PV installations and corresponding taxation issues are discussed.

The findings from the preceding document study are then used in developing **financial models** of hypothetical PV power plants launched in January 2015. The models are adjusted to reflect the specifics of each of the countries. Furthermore, the models distinguish between debt and equity financing or a combination of both. Finally, PV projects in both countries are evaluated using methods of capital budgeting and recommendations are proposed.

Methodology of the Thesis

The research section of this Thesis consists of two main parts. The first analysed legislative framework and regulatory policies related to solar installations and businesses in Germany and France in both national and international context. The second then extracted relevant pieces of information from the legislation overview for each state and utilized them in developing a model of a PV investment in line with legislation of the given state.

The first part of the analysis involved a thorough study of **documents and legislation** on national level, as well as on the level of the EU. Furthermore, a review of business structures adequate for running a PV project under was created, including taxation and financing implications.

Second part of the analysis applied findings from the first part onto development of a **financial model of a sample PV power plant (PVPP)** for each of the countries. Technical parameters of both model PVPPs were held constant, while country-specific parameters such as purchase prices, depreciation methods or profit taxation differed for each of the analysed countries. Finally, methods of **capital budgeting** were employed in order to evaluate the PV investment in each of the countries and using each of the types of financing.

Recommendations

Results of the conducted analysis speak clearly: Assuming the input parameters used in the model, an investor should implement the sample PV project **neither in Germany, nor in France**, no matter if he obtains the necessary funding through equity financing, debt financing or a combination of both.

The model of a PVPP in **Germany is not even close** to being able to capitalize, irrespective of type of financing used – even when not considering time value of money. This is due to a set of unfavourable settings, namely low purchase price with no indexation, less advantageous depreciation methods available and lower level of insolation. In order to reach an IRR of at least 5%, the initial investment would have to fall by more than two thirds, or the purchase price for produced electricity would have to increase by almost 2.5 times, or the efficiency of the solar panels would have to be more than doubled.

However, the model of the PV investment in **France** returns an **IRR of 3.13%** when using 100% equity finance. In other words, should the investor have cost of capital equal to or lower than 3.13%, he should undertake the project, as it would then have a nonnegative NPV. Debt financing of the PV investment in France under the given conditions is unprofitable and should not be used, as the cost of debt is higher than the cash inflows. Nevertheless, readjusting the model revealed that should the PV entrepreneur be able to get an **interest rate of 3.3%** or lower, the NPV of the project at 5% discount rate would be positive and the project should therefore be implemented.

In summary, the conducted analysis of investment in PV found out that under present conditions, **large-scale PV installations are not a very attractive field** to be in for investors. Author of the Thesis is of the opinion that this fact actually confirms correctness of existing **policies towards PV**. After all, if a country is able to cut down the profits of PV investors to the minimum and still meet the running goals for RES deployment, it can be interpreted as a great success for local policymakers. Overview of both German and French RE policy tools indicates that these countries are able to respond flexibly to the evolving PV market and tightly adjust their policies to the national targets for share of RE on energy consumption. Author sees this approach of policymakers to be rational and argues that RES and especially PV installations should not serve venture investors seeking high returns on investment. Rather, it should be households and small enterprises that should benefit from revenues guaranteed by favourable purchase prices of RE electricity.

The results of the analysis also imply an important lesson for businesses involved in the **PV supply chain**. These companies should focus on smaller PV systems designed for households and buildings, because those are the PVPPs that are the most supported by French (and to a lesser extent also by German) RE policy. In addition, new business models should be developed in order for PV businesses and investors to adjust to the evolving policies and benefit from them.

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