Master in the Electric Power Industry

Structure of the Master Thesis Proposal

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1. Proposal And Technical Data Cover.

The following sections will present the data related to the proposed master's thesis as well as the individuals involved.

- Title of the proposed Master Thesis:

Assessment of Photovoltaic Solar Energy: A Comprehensive Study in the Spanish Context

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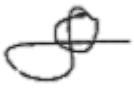
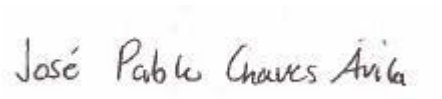


- Approval of the Supervisor



2. Master ‘s Thesis Proposal Content.

2.1 Introduction And Motivation

The expansion of renewable energy around the world has been driven by growing awareness of climate change and the transition to sustainable energy sources in the last decade. It has become evident that solar irradiation is a significant resource in the Iberian Peninsula, presenting significant potential for generating clean and sustainable energy.

As solar penetration increases on the Iberian Peninsula, there has been considerable interest in the electricity sector and our course of action moving forward. Technological advancements, coupled with favourable geographical conditions, have led to a significant rise in solar generation capacity. However, despite this growth, there exists a gap in the comprehensive understanding of the factors driving this upward trend of solar PV and the implications it could have on the regional energy landscape.

This master's thesis proposes a detailed analysis of this knowledge gap regarding solar PV penetration on the Iberian Peninsula. Local energy policies will be scrutinized to comprehend their contributions to the growth of installed solar capacity. Additionally, various technological advancements that facilitate the progression of this type of technology will be examined, along with the climatic factors driving and fostering its expansion.

In addition to this preliminary analysis, the economic, environmental, and social impacts of this expansion will be explored, as well as the ripple effects on various electricity markets and how it may influence future prices. To achieve this, time series regressions will be employed, involving the analysis of patterns, trends, and potential correlations to better understand how these factors contribute to the observed increase in solar generation capacity on the Iberian Peninsula.

This research not only aims to enhance the understanding of solar energy dynamics in the Iberian Peninsula but also seeks to contribute to developing more effective strategies for managing this renewable energy source in the region.

2.2 Objectives of the Master Thesis

It is intended that this thesis will elaborate on the following points or objectives:

Analysis of Current Energy Policies: Examination of existing energy policies and their historical trajectory will be conducted to comprehend the current context and the situation we have reached.

Study of Determining Factors: A comprehensive study of determining factors, such as weather variability and technological advancements influencing the rise of such technology, will be undertaken.

Temporal Evolution of Solar Penetration: Analysis of the Temporal Evolution of Solar Penetration. Over recent years, investigating and documenting the installed solar generation capacity in the Iberian Peninsula, identifying temporal patterns and trends.

Time Series Regression Modeling: Temporal regression techniques based on thorough chronological data analysis will be employed to quantify the relationship between previously identified factors and the expansion of solar energy. This methodology will be applied with the aim of understanding the dynamics of solar energy expansion, identifying significant patterns and trends over time.

As a starting point, ARIMA models (Autoregressive Integrated Moving Average models) will be implemented to analyze trends in photovoltaic generation. This approach will allow for the identification of seasonal patterns and the formulation of predictions about future energy production.

Additionally, a detailed statistical analysis will be conducted to represent non-numeric categorical variables, such as the impact of specific energy policies or regulatory changes on photovoltaic generation and its interaction with market prices, using Dummy Variables.

The study will also address the examination of the relationships between photovoltaic generation in the Iberian Peninsula and the electrical markets managed by the Iberian Energy Market Operator (OMIE) and the Spanish Electricity Network (REE). For this purpose, cointegration models will be used, which will facilitate determining the existence of a stable connection over time between these variables, suggesting that, despite experiencing fluctuations, they tend to move together, maintaining a long-term equilibrium.

Ultimately, the integration of the studies through the analysis of a statistical model that captures the linear relationship between multiple time series, including photovoltaic generation, electricity prices, and other relevant factors, will be considered, using VAR models (Vector Autoregressive Models) for this purpose.

This comprehensive approach will allow not only for an understanding of the evolution and impact of photovoltaic energy within the Spanish energy system but also for an analysis of how variations in photovoltaic generation influence and are influenced by energy markets.

Examination of Economic, Environmental, and Social Impacts: Examination of the economic, environmental, and social impacts resulting from the increase in solar generation capacity, providing a comprehensive evaluation of the benefits or drawbacks, as well as associated challenges

Contribution to Scientific Knowledge: The intention is to contribute to scientific knowledge that enhances the global understanding of solar energy dynamics and can be utilized for decision-making and information in the field of the energy sector.

Development of Conclusions and Recommendations: Finally, conclusions based on findings will be developed to offer specific recommendations for the sustainable integration of solar energy in the Iberian Peninsula.

2.3 Preliminary Table of Contents: chapters and main sections within each chapter.

Chapter 1: Introduction

1.1 Introduction and Motivation

1.2 Thesis Objectives

1.3 Thesis Structure

Chapter 2: Literature Review

2.1 Evolution of Solar Energy

2.2 Historical Analysis of Solar Capacity

2.3 Geographic and Climatic Context in the Iberian Peninsula

2.4 Climatic Variability in the Iberian Peninsula

2.5 Identification of Temporal Patterns and Trends

2.6 Factors Influencing Solar Penetration

2.7 Political Context and Energy Policies of Solar Generation in the Iberian Peninsula

2.8 Technological Advances

Chapter 3: Methodology

3.1 Research, Compilation, and Data Analysis

3.2 Analytical Tools and Techniques

3.3 Basic Concepts of Time Regressions

3.3 Study Limitations

3.4 Selection of Variables and Models

3.5 Interpretation of Results

Chapter 7: Study Results

7.1 Economic Analysis in Different Markets

7.2 Environmental Impact

Chapter 8: Recommendations for Sustainable Integration

8.1 Implications for Energy Policy

8.3 Future Perspectives

Chapter 9: Conclusions

Each of the sections indicated serves as a guide and will be adjusted throughout the study and analysis of the work.

2.4 Description of the Methodology That Is Going to Be Applied, And Selected References (Bibliography) To Be Used.

In this study, a methodology combining quantitative and qualitative methods will be employed to comprehensively address the complexity of solar penetration in the Iberian Peninsula. Below is a step-by-step description of the methodology:

Research:

Historical data on solar generation capacity in the Iberian Peninsula will be collected to analyse temporal evolution.

An exhaustive literature review will be conducted to contextualize the factors influencing solar penetration.

Data Compilation and Analysis:

Databases from distributors and main energy institutions will be used to obtain relevant information.

Additionally, descriptive statistical techniques and time series regressions will be applied to examine patterns and relationships.

Analytical Tools and Techniques:

Tools such as Python will be used to extract information from databases, as well as to carry out modeling and analysis.

Study Limitations:

The quality and availability of data may affect the breadth of analysis, as well as the interpretation and outcome of the same.

Selected References:

Various sources will be cited to support and contextualize the research.

DATADIS: https://datadis.es/home

REE: https://www.ree.es/es/datos/aldia

IDAE:https://www.idae.es/tecnologias/energias-renovables/oficina-de-autoconsumo/guias-tecnicas-sobre-autoconsumo

BOE: https://www.boe.es/eli/es/rd/2019/04/05/244

This list is indicative and will be expanded during the development of the work, incorporating relevant research and literature as progress is made on the thesis.

2.5 Work plan (by weeks) of the main tasks to finish the thesis in time.

To develop a detailed work plan based on the provided outline, let us break it down into clear and concise sections, assigning specific tasks, objectives, and deliverables for each stage.

Week 1-2: Preparation and Planning

Objectives:

Clearly define the study's objectives.

Select the main topic and establish the expected outcomes.

Tasks:

Conduct a brainstorming session to clarify objectives and the scope of the study.

Identify and list the primary research questions.

Review preliminary relevant literature for the theoretical framework.

Deliverables:

A list of objectives and research questions.

An initial bibliography of relevant sources.

Week 3-4: Literature Review

Objectives:

Identify key findings and gaps in existing research.

Outline a preliminary theoretical framework.

Tasks:

Conduct an in-depth review of the selected literature.

Take detailed notes on relevant findings and unexplored areas.

Begin outlining the theoretical framework based on the review.

Deliverables:

Summary of the literature review.

Initial draft of the theoretical framework.

Week 5-6: Methodology

Objectives:

Detail the data collection methods and analysis techniques.

Start the data collection and preliminary analysis.

Tasks:

Describe in detail the methodology to be used.

Begin data collection as planned.

Conduct a preliminary analysis to assess the methodology.

Deliverables:

Detailed methodology document.

Initial data collected.

Preliminary analysis report.

Week 7-8: Data Analysis

Objectives:

Perform an exploratory analysis of the data.

Apply temporal regression techniques to examine trends.

Tasks:

Conduct an exploratory analysis to identify patterns.

Apply and adjust temporal regression models.

Document preliminary findings and model adjustments.

Deliverables:

Preliminary results of temporal regression.

Week 9-10: Results

Objectives:

Interpret the results from the temporal regress ions.

Contrast the findings with existing literature.

Tasks:

Analyse the obtained results in depth.

Compare and contrast these results with previous studies.

Identify significant patterns or discrepancies.

Deliverables:

Detailed results report.

Comparison with relevant literature.

Week 11-12: Discussion and Conclusions

Objectives:

Integrate findings with the theoretical framework.

Draw firm conclusions and discuss implications.

Tasks:

Relate the results to the theoretical framework.

Discuss the implications of the findings.

Write the study's conclusions.

Deliverables:

Discussion and conclusions chapter.

Week 13-onwards: Final Drafting and Review

Objectives:

Integrate all components of the thesis into a complete draft.

Conduct revisions to improve quality and cohesion.

Tasks:

Compile and review the comp

Submit for revision and correction.

Adjust based on received feedback.

Deliverables:

Final draft of the thesis for review.

Final Weeks: Presentation Preparation

Objectives:

Prepare visual materials for the presentation.

Rehearse the presentation.

Tasks:

Create slides and other visual materials.

Conduct presentation rehearsals.

Adjust the presentation based on practice and feedback.

Deliverables:

Visual materials for the presentation.

Rehearsed presentation script.

This plan is flexible and may require adjustments. Constant communication with the advisor will ensure the project remains on track and adjusts, as necessary.