

**Economic Effects of the Energy System Transformation with a Focus on the  
Hannover Region**

**Masterarbeit**

zur Erlangung des akademischen Grades „Master of Science (M. Sc.)“ im Studiengang  
Wirtschaftswissenschaft der Wirtschaftswissenschaftlichen Fakultät der Leibniz Universität  
Hannover

vorgelegt von

**Name: Boeck**



**Vorname: Kevin**



**Prüfer: Prof. Dr. M. H. Breitner**

**Dötlingen, den 30. September 2016**

# Table of Contents

<b>Index of Figures</b> .....	<b>iv</b>
<b>Index of Tables</b> .....	<b>iv</b>
<b>List of Abbreviations</b> .....	<b>vi</b>
<b>1. Introduction</b> .....	<b>8</b>
<b>2. Overview</b> .....	<b>9</b>
2.1 Foundations of the German Energy System Transformation.....	10
2.2 The principle of local value added.....	13
<b>3. Research Design</b> .....	<b>16</b>
3.1. Theory of Economic Impact Analysis .....	17
<b>4. The Economic Effects of the Energy System Transformation with a Focus on the Hannover Region</b> .....	<b>24</b>
4.1. The Economic Impact Analysis .....	24
4.1.1 Study Type .....	24
4.1.2 Geographic Region.....	25
4.1.3 Economic Impacts .....	33
4.1.4 Indicators.....	42
4.1.5 Scenarios .....	47
4.1.6 Data Sources.....	61
4.1.7 Modelling .....	61
4.2. Modelling Tools.....	62
4.2.1 Approaches .....	63
4.2.2 Discussion .....	69
4.2.3 Recommendations.....	73
<b>5. Discussion on the Economic Effects of the Energy System Transformation with a Focus on the Hannover Region</b> .....	<b>74</b>
<b>6. Limitations</b> .....	<b>83</b>
<b>7. Conclusion</b> .....	<b>86</b>
<b>References</b> .....	<b>89</b>
Ehrenwörtliche Erklärung .....	I

## Abstract

The Energy System Transformation is a nationwide project which is significantly driven by the German government. The goals of the project have led to a complete transition of all economic structures. In this course, the municipalities have significantly gained in importance. Therefore, the objective of this study is to assess the Economic Effects of the Energy System Transformation with a Focus on the Hannover Region. For this, an Economic Impact Analysis is applied. It focuses on the expectable direct, indirect and induced effects as well as on the modelling difficulties in a regional scope. This study represents an underlying concept for a robust quantification of the Economic Effects of the Energy System Transformation in the Hannover Region by providing a holistic overview on appropriate economic measures, indicators and modelling approaches. The Economic Effects show a slightly positive trend, however, they are not of a great scale.

*Keywords: Energy System Transformation, Economic Effects, Hannover Region, Economic Impact Analysis, Renewable Energies, Full Economic Model Approach, Value Chain Analysis*

## 1. Introduction

The prime minister of Lower Saxony and former mayor of the Hannover capital Stephan Weil declares that *“the energy transition is a marathon, a generation project”* (Stephan Weil, 2014). Neutrally speaking, the Energy System Transformation is definitely a dominating project, officially driven by the German government. Since 2014, the investments in Renewable Energy plants have increased significantly, which is particularly based on the strong expansion of wind energy. The goals of the German government are ambitious, with key milestones in the years 2020 and 2050. By 2020, Renewable Energies shall amount to a share of 35% on the energy supply and in 2050 the gross final energy consumption shall at least be supplied by 60% from Renewable Energies (cf. BMWi, 2015, p. 13). In this study, the Energy System Transformation is understood with a view to the objectives and measures of the legislations by the German government.

Generally, the Renewable Energy industry can be seen as a cross-sectional industry that includes economic activities that are specifically related to the generation and installation of facilities for the use of Renewable Energies. However, an additional factor of the Energy System Transformation is the improvement in the Energy Efficiency, which aims to reduce the overall final energy consumption.

These long-term goals of the Energy System Transformation require a complete transition of all economic structures. It is of high interest to evaluate the results of this process. Overall, a rapid structural change has occurred in the recent years and it is set to continue. This leads to Economic Effects on all economic sectors and industries.

A frequently mentioned profiteer of this development are the municipalities. With the decentral orientation of the Energy System Transformation, they have enormously gained in importance. With this, the regional-economic potential of the Energy System Transformation through the strengthening of the local economic power is of increased interest. Within the municipalities, many hopes are connected to the Energy System Transformation. These can be summarized in an increase of the local value added. The Hannover Region is an economic prospering area, in which the manufacturing sector represents the biggest economic sector. There, the expectable effects of the Energy System Transformation are of high interest, too. In the course of the structural change, full transparency towards the affected people is beneficial to the project's success. Therefore, the motivation of this paper is to assess the value added effects resulting from the Energy System Transformation.

This research will establish the basis for a regional analysis in order to answer the main research question of the **Economic Effects of the Energy System Transformation with a Focus on the Hannover Region**.

To capture the effects on regional value added to their full extent, not only the direct effects were examined, but also the vertical value chain, including its indirect and induced effects. In this course, several approaches for the assessment of Economic Effects have been analysed with regards to their strengths and weaknesses. A recommendation for an appropriate modelling of the Economic Effects in a regional scope is worked out. This study provides the underlying concept for a robust quantification of the Economic Effects of the Energy System Transformation in the Hannover Region.

After a short overview on the aims and background of the German Energy System Transformation, the next will be to describe the applied research design of this study. In order to answer the research question, an Economic Impact Analysis is performed. This serves as the foundation for the discussion. The discussion pays a special attention to the identification of a suitable modelling approach for further research and the examination of the actual state. Furthermore, the expectable Economic Effects in the Hannover Region are outlined. Afterwards, the limitations of this study are described and advises for further research are provided. Finally, the study ends with a conclusion.

The foundation for a regionalized analysis of the expected value creation effects in the Hannover Region in course of the Energy System Transformation is laid with this study. It provides a holistic overview on appropriate economic measures, indicators and modelling approaches to perform a reliable regional economic analysis.

## **2. Overview**

It is important to know the political background of the Energy System Transformation in Germany in order to answer the research question of this paper. For instance, who are the main drivers and what are their main goals? Which incentives do they set and how are the plans adapted in the Hannover Region which is in the focus of this paper. In the recent years many laws and regulations have been approved to support the development of Renewable Energies, to expand the networks, to higher the Energy Efficiency and to improve the Energy research. In this context, the decentral aspect of the Energy System Transformation plays a significant role. Therefore, this Chapter

## 7. Conclusion

The Energy System Transformation leads to a complete transition of all economic structures. Its two main pillars are the expansion of Renewable Energies and the improvement of Energy Efficiency. This also counts for the regional scope of the Energy System Transformation. The municipalities have been identified as important actors in the entire transition process. They have the chance to participate in several ways, due to the shift from a central towards a decentral organization of the Energy System.

Generally, the Renewable Energy industry can be seen as a cross-sectional industry. Many different economic sectors, branches and upstream services are affected by Renewable Energy activities. There are companies that can be directly assigned to the Renewable Energy industry. However, many actors cannot be clearly assigned. This causes difficulties in the analysis of the effects resulting from Renewable Energy activities.

In general, studies on the Economic Effects of the Energy System Transformation face several issues, especially in a regional context. This is mainly caused by the lack of official statistics for sub-regions of the economy. The quality of data is the most crucial aspect for a robust analysis. Another difficulty is the identification of Economic Effects and their dimension, resulting from Renewable Energy activities.

To cover all the effects, this study has focused on all three dimensions of Economic Impacts. It has not only focused on the value chain itself, but also on the vertical value chain. With this, several activities and stakeholders, which participate in the Energy System Transformation, have been identified.

Furthermore, this study has pointed out the weaknesses of existing economic assessment models. It has highlighted the importance to conduct a net study, that focuses on the impacts in all economic sectors, including the negative ones, to draw an accurate picture of the expectable outcomes.

Moreover, it has outlined that a full economic modelling approach will generally provide the best results on the overall Economic Effects of the Energy System Transformation, as it includes all dimensions of Economic Effects and contains dynamic aspects that enables the model to forecast future developments. It has introduced the REMI Model and clearly described its advantages and disadvantages. It has shown that this model approach needs a high amount of data and, in the case that these cannot be provided, a simple approach should be chosen.

Therefore, the study has identified the value chain method, as a sophisticated approach to capture the complexity of activities and supply chains, related to Energy System Transformation activities. It has come to the conclusion to choose at least a mixture of a value chain analysis and an Input-Output-Analysis. In addition, this study has given advices to receive a robust data base.

Apart from the modelling approach, this study has given an overview on the expectable Economic Effects of the Energy System Transformation in the Hannover Region. It has pointed out, that the region fulfils the general criteria to generate positive Economic Effects. The two main pillars of the federal state driven project also apply to the Hannover Region.

The Hannover Region is characterized by an investment behaviour which is beneficial for the creation of local value added. In addition, it is able to participate in every single step of the value chain. The more activities are located in the region, the more of the total share will remain in the region. It can be expected that the expansion of Renewable Energies, as well as Energy Efficiency measures, will have positive effects on local company profits. This will also lead to employment effects and tax revenues. In addition, Research and Development activities will cause innovation effects that imply prospective competitive advantages of the Hannover Region.

However, this study has also observed the trend on a federal state level. In total, it can be assumed that the overall Economic Effects are not of significant importance. This study has shown that it will be the task of a future study, to assess these estimated Economic Effects in real quantities. When applying the results from the observation of the different model approaches, it can be estimated that the results will lie above the observed studies. This is caused by the fact since none of the observed studies is carrying a detailed analysis of the Renewable Energy industry.

A calculation based on a comprehensive, holistic approach would benefit a full transparency towards the affected people within the region. That can be seen as beneficial to the success of the project.

Regardless which approach is chosen, the reliability of the results strongly depends upon the quality of the input data and the underlying assumptions. Therefore, a good documentation of input data and assumptions is needed, to be able to assess the results.

This study has provided the underlying concept for a robust quantification of the Economic Effects of the Energy System Transformation with a Focus on the Hannover Region.

It provides a holistic overview on appropriate economic measures, indicators and modelling approaches to perform a reliable regional economic analysis.

Even when the trend is identified as slightly positive, the elaboration of the Energy System Transformation in an economic feasible way faces several issues. It is expectable that with an advanced stage, the obstacles and problems will increase, too. Thus, the statement from Stephan Weil can be considered as true. The energy transition is a marathon, a generation project.