

BUCHAREST UNIVERSITY OF ECONOMIC STUDIES

Council for Doctoral Studies

Doctoral School of Cybernetics and Economic Statistics

**FORECASTING METHODS AND TOOLS FOR
THE DEVELOPMENT OF A GREEN
ECONOMY**

CĂTĂLIN-LAURENȚIU ROTARU

PhD supervisor: Prof. **GIANI-IONEL GRĂDINARU**
Ph.D.

Bucharest, 2026

SUMMARY

The different contexts related to climate change and political causes have accelerated the transition of economies towards sustainability and towards the reconfiguration of energy sources, from conventional energy to renewable energy sources. These factors have also led to changes in the strategies in the field of digitalization through efficient processes and resources.

In this research, a first objective is to apply quantitative-descriptive analyses using digital visualization tools to understand how the economy's renewable and conventional energy sources operate. The second objective of the research is to perform quantitative forecasting analyses (such as Long Short Term Memory and Random Forest) to create an efficient green energy allocation framework.

The analysis showed that Romanian investors have a different perception of companies using renewable and fossil energy, compared to investors in Europe. The results showed that Romanian investors allocate capital proportionally to both types of companies – both those producing renewable energy and those producing conventional energy, while European investors allocate capital in the opposite proportion. It is also worth mentioning that, in Romania, there has been an increase in temperature, according to forecasting methods, which may affect the efficiency of photovoltaic systems in the long term.

The current thesis demonstrates how socio-economic factors, such as population income/a small number of consumers in certain administrative units, as well as factors such as meteorological factors, precipitation (which are expected to increase due to climate change), can support, depending on the case, a lower or higher feasibility in terms of green energy implementation.

Keywords: quantitative methods, green economy, digitalization, machine learning, efficient photovoltaic energy, climate change.

CONTENT

INTRODUCTION.....	Error! Bookmark not defined.
1. CURRENT STATUS OF DOCTORAL RESEARCH (FROM RELEVANT SCIENTIFIC LITERATURE)	Error! Bookmark not defined.
1.1. GEOPOLITICAL CONTEXT AND THE NEED FOR GREEN ENERGY IMPLEMENTATION.....	Error! Bookmark not defined.
1.2. THE IMPACT OF GREEN ENERGY ON THE ECONOMY.....	Error! Bookmark not defined.
1.3. CLIMATE CONSEQUENCES OF FOSSIL ENERGY ON THE ENVIRONMENT	Error! Bookmark not defined.
1.4. ECONOMIC CAUSATION IN GREEN ENERGY VS. FOSSIL ENERGY	Error! Bookmark not defined.
1.5. SUSTAINABLE PROGRESS THROUGH DIGITALIZATION OF THE ECONOMY.....	Error! Bookmark not defined.
1.6. SYSTEMS FOR IMPROVING THE ECONOMY DIGITALIZATION PROCESS.....	Error! Bookmark not defined.
1.7 SUSTAINABLE ECONOMIC DEVELOPMENT – THE IMPACT OF THE REAL ESTATE SECTOR ON GREEN SPACES	Error! Bookmark not defined.
1.8 UNSUPERVISED LEARNING METHODS AND THEIR USE IN THE DEVELOPMENT OF SOLAR ENERGY EFFICIENCY PROCESSES.....	Error! Bookmark not defined.
1.8.1 Clustering	Error! Bookmark not defined.
1.8.2 Principal component analysis.....	Error! Bookmark not defined.
1.9. SUPERVISED LEARNING METHODS AND THEIR USE IN EFFICIENT AND GREEN ENERGY PREDICTION	Error! Bookmark not defined.
1.9.1 Random Forest	Error! Bookmark not defined.
1.9.2 Logistic Regression	Error! Bookmark not defined.
1.9.3 Long-Short Term Memory	Error! Bookmark not defined.
1.10 LITERATURE SYNTHESIS AND RESEARCH DIRECTIONS FOR SUPERVISED AND UNSUPERVISED LEARNING METHODS	Error! Bookmark not defined.

2. RESEARCH METHODOLOGICAL PLAN	Error! Bookmark not defined.
3. CAUSATION AND EFFECT – CAPITAL MARKET INVESTMENTS FOR RENEWABLE ENERGY VS. FOSSIL ENERGY	Error! Bookmark not defined.
3.1 INTRODUCTORY FRAMEWORK AND DESCRIPTION OF CONVENTIONAL AND RENEWABLE ENERGY PRODUCING COMPANIES.....	Error! Bookmark not defined.
3.2 DESCRIPTIVE STATISTICS AND DATA PROCESSING...	Error! Bookmark not defined.
3.3 GRANGER CAUSATION - INVESTMENT IN RENEWABLE ENERGY COMPANIES VS. FOSSIL ENERGY COMPANIES	Error! Bookmark not defined.
4. SOLAR ENERGY EFFICIENCY THROUGH MACHINE LEARNING METHODS....	Error! Bookmark not defined.
4.1 CONTEXT AND CHAPTER INTRODUCTION	Error! Bookmark not defined.
4.2 QUANTITATIVE DESCRIPTIVE ANALYSIS AND DATA PROCESSING - AVERAGE MONTHLY TEMPERATURE IN ROMANIA.....	Error! Bookmark not defined.
4.3 QUANTITATIVE DESCRIPTIVE ANALYSIS OF MONTHLY AVERAGE PRECIPITATION IN ROMANIA AND DATA PROCESSING AND DATA PROCESSING	Error! Bookmark not defined.
4.4 METEOROLOGICAL PREDICTION OF TEMPERATURE AND PRECIPITATION AMOUNT FOR EFFICIENT SOLAR ENERGY ALLOCATION	Error! Bookmark not defined.
5. OPTIMIZING SOLAR ENERGY ALLOCATION USING ECONOMIC, SOCIAL AND METEOROLOGICAL FACTORS	Error! Bookmark not defined.
5.1. GENERAL OUTLOOK	Error! Bookmark not defined.
5.2. PRESENTATION AND DESCRIPTION OF INDICATORS THROUGH QUANTITATIVE STATISTICS	Error! Bookmark not defined.
5.3. APPLICATION OF RANDOM FOREST TO DEVELOP AN EFFICIENT SOLAR ENERGY ALLOCATION SYSTEM.....	Error! Bookmark not defined.
6. CONCLUSIONS AND FUTURE DIRECTIONS	Error! Bookmark not defined.
7. BIBLIOGRAPHICAL REFERENCES.....	Error! Bookmark not defined.
8. APPENDICES	Error! Bookmark not defined.
ABBREVIATIONS	Error! Bookmark not defined.
LIST OF GRAPHICS.....	Error! Bookmark not defined.

LISTA TABLES	Error! Bookmark not defined.
--------------------	-------------------------------------