

# Preface

This book is the synthesis of the results of several research activities during our previous 10 years of experience in energy planning and modelling. While some elements of this work have been published in a Ph.D. thesis, journals and proceedings of international conferences, until now there had been no single resource that described all of these works in a unified view. These scientific and practical experiences are the basis of this book. However, new observations and experiences have also been included, and the discussion is organized for a broad audience.

The central problem discussed here is that the local infrastructure, e.g., energy systems, has numerous and diverse subsystems, nonlinear interactions, multiple scales and heterogeneity. Planning and modelling such systems over the long range is a complex task connected with different uncertainties. In addressing this problem, the reader will find answers to several questions such as:

- What is energy infrastructure planning in cities and territories, and which planning steps and phases exist?
- What are the main requirements and quality factors of methods or methodologies supporting integrated planning in cities and territories?
- What is uncertainty in a model-based local planning context, and which types of uncertainty exist?
- How are different types of uncertainty allocated according to planning and modelling procedures?
- Which types of uncertainty are addressed in the planning literature, and which methods and methodologies have been used to address different types of uncertainties yet?
- Which method or set of methods based on which paradigm is most appropriate for modelling and uncertainty analysis in a coherent, comprehensive and pragmatic way?
- How does one avoid the strong cut consideration between a developed model and its environment to avoid uncertainties and model complexity?
- What is the return of the experience for the proposed modelling and uncertainty analysis approaches according to defined quality factors?

This book has eight chapters. Chapters 1 and 2 introduce practical and research contexts, problems, energy infrastructure planning and several background theories. Chapter 3 discusses a deterministic view of modelling and planning proposing 3 domain-modelling concepts; Chaps. 4 and 5 discuss a stochastic view of modelling and an uncertainty analysis suggesting two multi-method approaches for uncertainty analysis based on probability and fuzzy set theories, respectively. The applicability of the proposed multi-method approaches for modelling and uncertainty analysis is illustrated in Chap. 6 in two different ‘Use Cases’ and is then evaluated in Chap. 7. Chapter 8 concludes with the main outcomes, discusses the limitations and proposes future work. Many different individual methods for modelling and uncertainty analysis are reviewed and discussed according to the defined quality factors in different chapters. Some additional empirical results are presented in the appendixes.

In this volume, theories, methodological backgrounds and practical implementation in case studies will help not only understand the proposed methodologies for modelling and uncertainty analysis but also show how these approaches are working in practice and the empirical outcomes and performance of these approaches. The proposed approaches can be implemented not only in the context of energy planning but also in other infrastructure planning, such as transportation or water resources planning, and on the level of national planning.

We hope that business professionals, city or territory planners, researchers or students using this book will have several advantages, e.g., learning, discovering future research areas or implementing the proposed methodologies in real case studies to cope with the complexity and uncertainty successfully.

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Applications in Long Range Infrastructure Planning

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