

# Preface of the Editors

The energy supply system of today is one of the biggest and most complex physical systems humanity has ever built. As this book will show, it is not only a highly sophisticated physical machine, but also a complex world, including energy trading, regulation, societal effects, geopolitical strategy, climate change, and international security. For successful management, these worlds cannot be treated in an isolated manner. Instead, the energy supply disciplines have to be seen not only within the scope of their individual disciplines, but also, and almost especially, in their current interactions and interdependencies within the energy system as a whole.

We are grateful for the many lessons we have been honored to learn from our authors from all over the world. The perspectives and knowledge shared within this book span four continents, including experts from Australia, Austria, Canada, France, Germany, India, Latvia, the Netherlands, Norway, Switzerland, and the US. The course of this book has taught us, the editors, the true scale of the current global energy supply system. Modern energy supply is as interdisciplinary as it is international. Each region and country have their own starting position and boundaries with regards to their energy provision and the energy transition. Changing a parameter in one country will likely affect in some way the global energy system as a whole. Connected physical systems have no political borders. Hence, where a policy or a change in energy export and import strategies might seem successful when regarding it from an isolated national perspective, the global perspective might differ. This book invites you, the readers, to join us on a journey, across professional disciplines, responsibilities, and continents, to explore the facets, key components, and motivations of the energy supply system of today. It also shows the many different perspectives that need to be accounted for when working in the energy sector. Despite the many and sometimes contradictory perspectives, we found all authors clearly united in one: The true passion and compassion for their topic and their genuine care to make the energy system work.

It is this spirit that we would like to pass on to you, our readers.

## The Energy System: More Than Just Electrics

In the industrialized world of today, a high security of energy supply has practically become taken for granted by most citizens, economies, nations, and regions alike. Accordingly, and at a first glance, the world of energy supply may appear as a largely homogeneous sector—an industry based on tried-and-tested structures and processes, that have been developed over decades, seamlessly providing services on a mostly even keel.

But is this initial impression of simplicity and unity possibly deceptive? Are the protagonists in the energy sector perhaps not always speaking the same language? Can it be assumed that they share the same understanding of the system at hand?

Similar to other industries, a closer look at the energy sector reveals that it consists of two almost parallel worlds. The first is the world of physics, technology, and technical

operating processes. The second is the world of business, assets, regulation, and legislation, in addition to customer services and interactions. These two worlds represent the defining poles of the utility industry. In simplified terms, these poles are summarized in this book as “technology” and “business.”

And even within professional disciplines, the need for a “translation aid” is increasingly important and necessary. The ever more sophisticated nature of current technical systems and the long operational times of equipment in the energy sector, with some systems being older than a century, make the required communication and knowledge exchange between professionals with a scientific background on the one hand and professionals with an operational or management background, on the other hand, challenging.

This background motivated us and our authors from all over the world to write this book. We will not hide some bad news first: Establishing and revitalizing the dialogue between technology and business, science and practice, does not only sound challenging or even difficult, it actually is. The good news is that nobody is stopping us from establishing a fair interdisciplinary dialog with a lot of goodwill and curiosity right now.

### **Time for a Dialog Between the Disciplines**

So let’s start right away with this interdisciplinary dialog between technology and business!

But why do we, the editors of this handbook, think that now is the right time for an initiative to bring the two worlds closer together in the energy industry? In our opinion, the answer is surprisingly simple: it is the complexity of the current system. We are living in an increasingly complex reality today. While this applies to almost all areas of life, it applies particularly to the energy sector. After all, the sector is currently faced with several drivers of complexity: Firstly, the dominant influence of regulation with its frequent changes to laws and the legal framework is significantly aggravating the pressure on energy supply companies to adapt. In addition, municipal utilities and energy suppliers of all kinds have been undergoing an epochal digital transformation process for several years, at the end of which these companies will have transformed themselves into Utilities 4.0. And finally, the industry must reinvent itself in such a way that it can meet the new requirements of increasingly confident and climate-friendly customers and prosumers on the one hand, while on the other hand being able to defend itself against an ever-increasing number of new, digital-savvy players in its traditional market.

In addition, the energy supply environment is coming under increasing pressure. Climate change with its associated severe weather events; major crises, such as the COVID-19 pandemic, and a changed geopolitical environment uncover and highlight the weak points of our existing energy supply structures. The established design and operation of supply chains become increasingly challenged, and highly complex systems complicate troubleshooting efforts. More and more, resilience aspects are coming to the

forefront. Energy supply is being viewed more systemically, as sectors are being linked and optimized together. These developments make adjustments necessary. The often immense and quite short-term pressure to act is unique in the history of energy supply. Such transformation processes regularly result in long-term developments, particularly in the complex energy sector. Some of the background to this, such as the investment periods and the deployment times of operating resources over decades, are covered in the chapters of this book.

All these aspects and developments clearly affect the strategic management and the operative day to day business of energy suppliers of all sizes. And although it might be tough to admit, the level of complexity of the current world makes it impossible for an energy supplier to sustain and maintain all required knowledge and information at all times and all by itself. Collaboration and knowledge exchange and also a certain humbleness to realistically assess the limits of acquired knowledge are called for.

This is what motivated us to invite you, our readers, to embark with us on a journey and on a new path mentioned at the beginning. Our declared aim with this book is to create the basis for a sound understanding of the different perspectives of relevant disciplines in the energy sector. In order to do justice to the claim described, we have made the unique attempt to date for a specialist book on the energy industry to present all aspects in a direct dialog between technology, management, and business.

### **Being Understandable is not a Given**

Our aim as the editors is to bring the technical and economic worlds of energy supply closer together. We would love to empower representatives of the technical and economic hemispheres to put on the glasses of the other side with an open mind when reading the book, and ideally also well beyond that. The successful solutions of the future require that the two poles of technology and business really understand each other in terms of content. After all, outstanding solutions can only arise from genuine mutual understanding.

Sounds sensible, sounds simple. But how does a power plant operator explain a brilliant technical idea to a business-driven board member? How can a plant manager explain to an energy trader that a disrupted operation is more or less a regular operation? And finally, how can a controller convince his technically oriented colleagues that the latest business model idea is unfortunately not fundamentally profitable? As project managers and management consultants, we have encountered these, and many similar questions time and again. And they were by no means always answered satisfactorily.

In our experience, the key factor often lies in comprehensible communication and systematically closing information gaps. Comprehensibility in communication, an unbiased willingness to close gaps in technical and non-technical knowledge and the ability to explain the basics of one's own specialist field to the other person are the guarantee for long-term success. However, we have found that such a suitable translation aid between the technical and commercial energy world is missing in operational practice.

This specialist book has been written against the background of the information and understanding gaps on both sides described above. Together with our authors, we want to use this work to stimulate and promote interdisciplinary dialog within the energy industry through an understandable comparison of technical and economic content. In a way, this handbook acts as an interdisciplinary translation aid between the disciplines. And thanks to its breadth of content and structuring along the energy industry value chain, this book is also suitable as a clear, quick introduction to the diverse topic of electrical energy supply.

The energy world is changing—as this handbook impressively shows. The basic knowledge of the energy world today goes far beyond purely electrical systems. The chapters show that the days of centrally controlled, purely electrical energy systems, in which each energy supply company was isolated in its geographical area, are over. And a new era is also dawning in digitalization, which includes new technologies, such as Internet of Things (IoT) and artificial intelligence (AI), but also represents a trend reversal from the longstanding premise of limitless and often unquestioned networking. For the first time in a compact handbook on the subject, there are also considerations on energy cells and sector coupling, but also on the trades, billing, psychology, and the basics of modeling as well as blackouts and power shortages.

In addition, the classic fundamentals of electrical energy supply are represented by renowned experts.

The future of energy supply will be exciting and complex—congratulations on having this book on your side!

### **Support is Everything . . . Thank You!**

The initial idea for the book began about three years before its first publication in the German speaking areas. A period that was filled with numerous discussions about the topic, the gradual concretization of the project, the search for our highly valued co-authors, and finally the actual text work through to the production. It is no exaggeration that by the publication of the book at hand, several thousands of pages have been worked upon until we were satisfied with the content. In other words, between the initial idea and the final work lays a long journey. A journey that would never have been completed so successfully without the many collaborators behind the scenes and the enormous commitment and profound knowledge of all contributors.

We would therefore like to express our sincere thanks to all the authors who contributed to this book. Our very special thanks go to the former EU Commissioner for Energy, Prof. Andris Piebalgs, and the Chief Technology and Chief Strategy Officer of Siemens AG, Dr. Peter Körte, for their inspiring and thoughtful forewords and for their generosity in sharing their expertise in the context of this work.

We would also like to thank our friends and supporters for their active support throughout the entire creative phase. Finally, our special thanks go to the entire team at the Walter de Gruyter publishing house, who made a significant contribution to the

success of this handbook on electrical energy supply. As representatives of the excellent support from the publishing house, we would like to mention Ute Skambraks and Damiano Sacco, whose great commitment accompanied the entire project. Our very personal thanks, however, go to our families, who—again!—allowed us to invest many hours of our free time in this book project.

### **May the Dialog Bear Fruit**

As mentioned, this work has been produced in an interdisciplinary manner and in a constant dialog between us editors and our authors, but also in a close exchange between the authors themselves. The book is therefore the direct result of the interdisciplinary discourse between technology and economics, but also between theory and practice.

In this handbook, you will find the collective knowledge of renowned experts and experienced practitioners of the key research fields and fundamental operational corner stones of electrical energy supply. With great dedication, work, and passion, our authors made the time on top of their demanding professional realities and private commitments to compile and share their knowledge, experience, and expertise. The wide span of their backgrounds is a reflection of our energy world, which, as this book also shows, is facing one of the greatest transformation processes in its history.

The idea of dialog is therefore an essential foundation of this book. Thanks to the dialog between technology and business, we editors have learned a lot ourselves. Together with our authors, we would be delighted if you, dear readers, would enjoy reading this book and if the dialog that has now begun between the worlds would bear further fruits.

Munich, Germany, and Nova Scotia, Canada, June 2024

Oliver D. Doleski  
Dr.-Ing. Monika Freunek

