

# Preface to Transitioning to Affordable and Clean Energy

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In 2015, the United Nations Member States adopted 'The 2030 Agenda for Sustainable Development', which provided a vision and a roadmap for a sustainable future, bringing peace and prosperity for people and our planet. This document is not just a utopian vision of the future but has at its core 17 Sustainable Development Goals (SDGs), which were a call for all countries to act in a global partnership to end poverty, improve health and education, reduce inequality, encourage economic growth, tackle climate change, and preserve the forests and oceans.

This book is dedicated to SDG 7, which is tasked to 'Ensure access to affordable, reliable, sustainable and modern energy for all'. The importance of the goal is emphasised by a few statistics identified by the United Nations. Over three-quarters of a billion people lack access to electricity, and one-third of the World's population relies on dangerous and inefficient cooking systems. In particular, there is a need to improve the efficiency of energy generation and usage and to accelerate the development of modern renewable energy technologies and infrastructure. Of all of the SDGs, SDG 7 is the most likely to have an immediate impact on people's daily lives, whether through changes in technology, transport systems, or energy tariffs.

For me, SDG 7 is also one of the most interesting goals, as it involves dialogue and interactions between scientists, technologists, the private sector, general society, as well as decision-, policy-, and lawmakers. I have had a long research involvement with the development of new compounds and materials for use in photonic applications, in particular, solar energy photoconversion using dye-sensitised solar cells, and efficient lighting devices incorporating ionic transition metal complexes in light-emitting diodes and light-emitting electrochemical cells. A number of years ago, I realised that our search for proof-of-concept materials or improved efficiency was resulting in the development of technologies that were themselves non-sustainable and were based upon rare and expensive resources such as the platinum group metals. This resulted in a change in emphasis within the research group to concentrate upon the use of Earth-abundant elements with minimal ecological or biomedical impact.

This volume comprises nine chapters which emerge from many of the sectors involved in the implementation of SDG 7. The first chapter begins in the science and technology area; in 'Materials Development towards a Sustainable Energy Future',

Diale, Fru, and Kyesmen survey the emerging materials which are attracting attention in photovoltaic and related devices. In particular, they discuss the use of haematite, an Earth-abundant iron-based material which does not have optimal electronic properties, and the halide perovskites, which exhibit excellent performance but are based on the use of environmentally hazardous materials such as lead.

This is then followed by three chapters relating to the deployment of novel technologies and their societal impact. The first, by Aliabadi, Thrän, and Bezama, 'A Systematic Analysis of Bioenergy Potentials for Fuels and Electricity in Turkey: A Bottom-Up Modelling' examines the under-exploitation of bioenergy in the mosaic models for energy production. This is followed by a study of the use of storage and renewable electricity generation for reducing domestic and transport carbon emissions by Stevenson. This real-world study is subtitled 'Energy and Cost Analysis of Single Dwelling Case Study (UK)'. Rodrigues and Lemos de Sousa discuss the contribution of geology for carbon capture and storage, as well as underground energy storage, in their chapter entitled 'Clean Energy Transition Challenge: The Contributions of Geology'.

One of the very important ways in which the broader society will be impacted by, or at least made aware of, the implementation of SDG 7 is in changes to transport systems, and this is examined by Vaz in the chapter 'Clean Transportation and Public Transit Challenges in Sparsely Populated Countries'.

Sermyagina, Lipiäinen, and Kuparinen examine measures currently being considered and evaluated by the wood-related industry in Finland, which is responsible for 2% of industrial fossil CO<sub>2</sub> emissions worldwide, in their contribution 'Finnish Forest Industry and Its Role in Mitigating Global Environmental Changes'.

The chapters in the last section of the book comprise the final group of chapters, which are related to societal aspects of the energy turn. An operational approach for developing community entrepreneurship, driven by financial flow from the renewable energy sector, is examined by Lombardi, Prospero, and Fascia, in their chapter 'Social Innovation for Energy Transition: Activation of Community Entrepreneurship in Inner Areas of Southern Italy'. In particular, they analyse cultural assets, tourism initiatives, and the potential for civic revitalization and conclude that the energy transition could represent an opportunity to spur economic growth with a multiplier effect on local communities. The final two chapters are concerned with the systems requirements of the energy transition. Pallonetto identifies the consequences of decarbonization strategies on the energy supply systems as intelligent buildings become more common and recognises the need for system-wide integration, in the chapter 'Advanced Energy Management Systems

and Demand-Side Measures for the Full Decarbonisation of Our Society’. In their chapter ‘Transition towards Affordable Electricity: Tools and Methods’, Hanif, Bhatti, Alam, Massier, Ramachandran, Ahmad, and Zhang analyse the tools available for modelling and evaluating district-scale electric grids and suitable applications for specific tools are identified based upon a distribution system test case for Singapore.

Overall, this volume brings together many of the aspects with which society will be confronted in the energy transition required by the implementation of SDG 7. I hope that this heterogeneous collection will encourage the reader to delve into areas outside her or his area of expertise.

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