Preface

In order to contribute to the training of young scientists working in the energy sector or intending to do so, the European (EPS) and the Italian (SIF) Physical Societies started the Joint EPS-SIF International School on Energy as a collaborative initiative. The Courses are foreseen to take place on a biennial basis in the beautiful venue of Villa Monastero in Varenna, Lake Como, Italy. The 1st Course was held in summer of 2012 on "*New strategies for energy generation, conversion and storage*". The 2nd Course in 2014 was devoted to an overview of "*Basic concepts and forefront ideas on energy*", covering the major scientific areas. The 3rd Course was exceptionally held in 2016 at the Ettore Majorana Foundation and Centre for Scientific Culture (EMFCSC), in Erice, Italy, in collaboration with the Materials Research Societies (MRS and EMRS), on "*Materials for energy and sustainability*". The 4th Course of the Joint EPS-SIF International School on Energy was organized in 2017 back to Varenna. The focus was on "*Advances in basic energy issues*".

The primary goal of the School is to present all research and development fields with relevance for the technologies of energy production, conversion, transmission and savings. The unique feature of the School is its multidisciplinarity and interdisciplinarity including basic and applied topics but also climate and economic aspects. This wide scope of the School is essential in order to provide the students with a global insight into the complex nature of energy supply and consumption. For this purpose, this School effectively brings together a large number of scientists working in different disciplines but all related to energy technologies with young scientists from all over the world.

The 4th Course of the School gathered 55 participants —lecturers, observers and students— of 10 different nations. The lectures were delivered by about 20 experts in various fields. The concepts and ideas involved in modern energy systems and technologies were clearly addressed by the lecturers who invested every effort to be as didactic as possible. Students and lecturers stayed together during lunch and dinner. The attractiveness of the venue helped to keep all parties on site for the whole week. In this way knowledge gaps were filled, and answers were provided to long-standing questions in the mind of the students during lively discussion-times that followed each lecture. In this way, a community formed and the basic idea of such a summer School was fully met.

The proceedings of the School, published as Lecture Notes, conserve the teaching material presented and make it available to those who did not attend the School. They serve as a reference book for both specialists working in one of the energy fields but with interests in the status of other energy-related areas, and non-technical readers who want to get a general overview on the involved concepts and techniques and their prospects. Papers are ordered according to topics: global overview of world energy resources, renewable energies (including geothermal energy), nuclear energy (fission, and fusion), energy economics, energy and grids, energy storage. These proceedings are published both on paper, in a volume of the "*Lecture Notes of the Joint EPS-SIF International School on Energy*" series, and on-line open-access in The European Physical Journal Web of Conferences (EPJ WoC).

We are especially grateful to all our distinguished colleagues who have accepted to write and timely provide their contributions for these Lecture Notes. Our thanks go as well to our many sponsors. Finally, we are grateful to our Scientific Secretary, Gianluca Alimonti, for his dedicated work concerning the programme of this Course and these proceedings, and to the staff of the Italian Physical Society for their warm and efficient hospitality in Varenna.

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