

Preface

This book is devoted to offering a one-stop source of information to engineers, economists and other professionals, as well as graduate students in renewable energy technologies and climate change activities. The book includes the main current statistics and the state of the art in the different topics related to all renewable energy technologies, carbon capture and storage, energy and electricity storage and smart grids. The most important up-to-date numerical data related to efficiencies, energy capacities and lifetimes of the systems, production costs, energy payback ratios, carbon emissions, patents and literature statistics, are exposed in 17 chapters, 247 figures and 49 tables, integrated in terms of units and methodology. All these data are also analysed in the book as a means to project future grid and fuel parity scenarios, and future technology tendencies in the different areas exposed. The book contains 405 references to books, briefings, reviews and research articles, mostly published in 2009–2012.

The book starts with an executive summary including a resume of the main data related to renewable systems and energy production costs, state of the art and environmental impact for each technology. The following chapter includes a brief description of the current use and theoretical potential of renewable and conventional energies, the evolution of the CO₂ emissions and atmospheric concentration and their influence in the climate change, generation costs of renewable fuel and electricity, the technological current status and the environmental impacts of the renewable energy technologies. The scheme followed in each of the technology chapters is identical: (1) overview of the technology and global updated energy production and capacity; (2) current status and key technologies; (3) current and future cost scenarios; (4) carbon emissions, energy payback and external costs; (5) technological trends; (6) pre-production and innovation highlights in 2009–2011 and (7) analysis of patents and literature statistics.

All values of the energy costs exposed in the book have been referred to 2011, mainly considering US and EU inflation indexes. To define the EUR/USD equivalence, we have considered the 2011 average exchange rate between both currencies. To evaluate the grid parities for the different renewable technologies, the following data have been selected: (1) the annual average electricity price forecasts in the

reference scenario at nominal USD per kWh (2011–2030) (EIA); (2) the electricity prices in the Iberian trade market and (3) the retail electricity prices published in the IEA Key World Energy Statistics. The electricity prices selected to graph grid parities for decentralised renewable technologies have been the US industrial and residential end-users EIA forecasts. The electricity prices selected to graph grid parities for centralised renewable technologies have been the US prices for generating services and the linear adjustment of the average electricity price in the Iberian trade market between 2000 and 2011.

To discuss global energy figures (mainly supply, capacities and production), we use the IEA Statistics Database. We consider this source very rigorous, but the methodology employed produces 2-year delayed data with respect to present. To compensate this drawback, in many chapters more updated estimations, provided by global and prestigious associations related to the specific technology, are referred.

For the analyses of the evolution of the number of patents for the different technologies, we have considered the publication date instead of the application date.

The data and the subsequent analysis provided in the text will be annually updated, as new data from different recognised sources are continuously collected and analysed by the authors. The sources considered are only international reputed agencies, energy departments of G8 countries, recognised international energy associations and top impact index journals. The description of pre-production and innovation highlights presented in each technology chapter are always extracted from past 3-year published top impact index journals, listed in the Journal of Citations Reports and from qualified and specialised news media.

This book surges from the work produced by the authors within the programme “Energy and Climate Change” (2008–2011) of the Foundation for Applied Economic Research (FEDEA) and funded by the Focus-Abengoa Foundation. This programme had the aim to analyse the economic, technological and environmental impacts of the different renewable and associated technologies to define the role of each in the configuration of global and regional future energy mixes. Once the targets of the programme were met, the authors decided to update the information, adding also new content and publish it in book form.

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The authors are available for readers to discuss any data or analysis published in this book and to propose any additional and recognised contents for next editions (rglemus@ull.es). Any reader who collaborates in the enrichment of the topics in future book editions will be recognised as collaborator of the edition where his/her contribution is added.

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