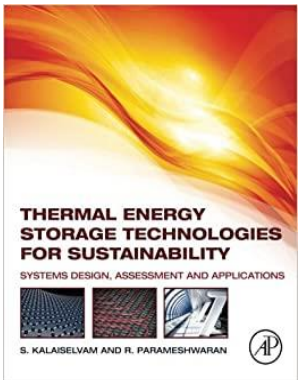
Cansu Noberi, Kenan Şentürk, Oğuzhan Murat Halat, Atakan Kaya, "Book Review-2: Thermal Energy Storage Technologies for Sustainability: Systems Design, Assessment and Applications", **Journal of Sustainable Economics and Management Studies**, Vol. 1, Issue 1, Dec. 2020, pp. 87-89.

BOOK REVIEW-2

Cansu NOBERİ[*], Kenan ŞENTÜRK[**], Oğuzhan Murat HALAT[***], Atakan KAYA[****]



Thermal Energy Storage Technologies for Sustainability: Systems Design, Assessment and Applications

Authors: S. KALAISELVAM, R. PARAMESHWARAN

ISBN: 9780124172913

Energy has always been a major challenge for human life. As emphasized in Brutland Report in 1987 "sustainability" is a concept that all countries must consider in order to have a role in the future. Nowadays energy consumption is a worldwide problem. In order to overcome this problem and save energy for the next generations, energy storage materials have gained much attention. Thermal Energy Storage (TES) technology is particularly requisite since it delivers sustainable energy solutions for potential future energy problems. This book, Thermal Energy Storage Technologies for Sustainability; Systems Design, Assessment, and Application, presents the phenomenon of thermal energy storage and explains various methods for saving thermal energy, and provides strategic plans to combine TES technologies with real-world problems.

The book starts with the definition of energy and energy consumption. The first two chapters, which are "*Energy and Energy Management*" and "*Energy Storage*", provide an overview of energy in terms of global energy demand and consumption. The categorization according to energy demand/consumption was done under the fossil, transition, and post-fossil eras, and brief explanations were given related to these eras. Attention is also drawn to the importance of nuclear energy including

[*] Asst. Prof. Dr., Istanbul Gelisim University, Faculty of Engineering & Architecture, Department of Mechatronics Engineering, E-mail: cnoberi@gelisim.edu.tr https://orcid.org/0000-0003-0264-3678
[**] Asst. Prof. Dr., Istanbul Gelisim University, Faculty of Engineering & Architecture, Department of Mechatronics Engineering, E-mail: ksenturk@gelisim.edu.tr https://orcid.org/0000-0001-8413-7570
[***] Res. Asst., Istanbul Gelisim University, Faculty of Engineering & Architecture, Department of Civil Engineering, E-mail: omhalat@gelisim.edu.tr https://orcid.org/0000-0001-7595-8422
[****] Res. Asst., Istanbul Gelisim University, Faculty of Engineering & Architecture, Department of Electrical and Electronics Engineering, E-mail: kaya.atakan94@gmail.com https://orcid.org/0000-0001-8176-3576

fission and fusion energy. The major energy challenges necessitating the implementation of energy efficiency measures were listed in the first chapter. Chapter 2 is mostly related to energy storage and starts with the well-known law of conservation of energy, which claims energy can neither be created nor destroyed but can be transformed from one form to another. After mentioning the significance of energy storage, the types of energy storage in means of mechanical, chemical, magnetic, hydrogen, and biological media are mentioned. The thermal energy storage is divided into low-temperature thermal storage and medium and high-temperature thermal storage. The basic principles of operation of these storage systems are defined. The most remarkable part of this chapter is where various energy storage systems are technically evaluated and then compared.

Authors define possible energy problems and solutions to overcome them with the help of different TES technologies which are favorable for a sustainable future. In Chapter 3, which is named "*Thermal Energy Storage Technologies*" TES technologies are discussed and sub-categories of TES, which are "*Sensible Thermal Energy Storage*", "*Latent Thermal Energy Storage*" and "*Thermo-Chemical Energy Storage*", are explained in detail through Chapter 4-5-6, respectively. Chapter 7 is all about "*Seasonal Thermal Energy* Storage" which differs from the other three sub-categories as the resource of the thermal energy is natural, whereas the others are not. As an alternative energy storage "nanotechnology" is also elaborated in Chapter 8. As we all know, nanotechnology is a hot and trendy topic since it can evaluate almost every property of a material in a positive way.

In Chapter 8, Nanotechnology in Thermal Energy Storage, authors pay special attention to nanotechnology since every property of a material could be changed and improved profoundly in a nano-scale in comparison to the same material on a macro-scale. The phenomenon of nanomaterials is discussed in detail in terms of both synthesis and characterization methods in order to understand the effect of size and shape of the nanomaterials which added into latent heat storage materials (likewise PCM) to enhance their thermal storage performance. In Chapter 8, it is also emphasized that despite having some challenges in the production and usage of nanomaterials, they are all preferred because through nanomaterials energy consumption can be reduced and materials like PCM can show remarkable effects in terms of thermophysical and thermochemical properties when they are manufactured using nanomaterials as a doping material.

In Chapter 9, "*Sustainable Thermal Energy Storage*" thermal energy storage systems are observed from a sustainability perspective. The topic is well examined with various and widely used implementation instances around the globe. Besides the thermal energy storage systems, to increase the overall efficiency of the system, renewable energy system integrations such as solar, wind, geothermal and combined heat and power system are also recommended to use. Chapter 10, "*Thermal Energy Storage Systems*

Design" and 11, "Review on the Modeling and Simulation of Thermal Energy Storage Systems" are all about modeling and designing thermal energy storage systems. Designs are supported with calculations and simulations. Chapter 12, "*Assessment of Thermal Energy Storage Systems*" focuses on the assessment of thermal energy storage systems considering energy supply, and demand, contribution to reduced greenhouse gas (GHG) emissions into the environment. Based on these perspectives, energy, and exergy concepts are mainly viewed and definitions of these terms, the distinction between them, their role in performance or assessment of systems, merits, and limitations of these systems are explained. Chapter 13, "*Control and Optimization of Thermal Energy Storage Systems*" is mainly based on controlling and optimizing the thermal energy storage systems. It mentions the control systems and methodologies and their types such as PI, PD, PID, fuzzy logic, artificial neural network or hybrid systems. Also, this chapter focuses on shifting the peak load periods through the incorporation of thermal energy storage systems by using different control strategies and explains improving these systems by analysis taking into consideration real-time parametric disturbances.

The future of TES technologies and the expectations are elaborated in Chapter 14, "Economic and Societal Prospects of Thermal Energy Storage Technologies". Cost analysis and economic feasibility of TES systems are evaluated using latent and seasonal TES systems. Societal implications of TES systems can be mainly summarized as; reduction in the usage of fossil fuel-based energy sources, reduced greenhouse emissions, reduced electricity and energy costs, economic feasibility. In addition to those, there are limitations such as; issues related to the storage and keeping the temperature constant, space requirements, operation and maintenance issues. As a final of the book, Chapter 15, "*Application of Thermal Energy Storage Systems*" focuses on the applications of TES systems considering active and passive systems, carbon-free thermal storage systems, low energy building design, and future developments. The efficient active or passive TES system can be performed depending on the location, environmental conditions, and thermal load demand of the buildings. The carbon-free thermal storage systems are explained with solar energy, which has to be stored suitably in order to be reused when demand rises and two important factors for solar TES systems are given as requirement of a larger area for collection of heat energy and size of a heat storage facility. The integration of Latent Thermal Energy storage (LTES) systems in buildings are also mentioned with their application potential which can be classified as space heating, space cooling, and air conditioning.