

# Preface

Efficiency has become a prime topic in energy studies, and has attracted a great deal of attention from all disciplines from mechanical engineering to physics and from electrical engineering to architecture. Efficiency calculations are commonly used to evaluate systems, applications, processes, and services in every sector, ranging from industrial to residential and from utility to commercial. Efficiency evaluation is considered a key component in assessing the performance of energy systems.

The two main principles of thermodynamics are the first and second laws of thermodynamics which lead to energy efficiency and exergy efficiency, respectively. A few decades ago, a thermodynamic analysis involved the evaluation of energy efficiencies only without consideration of second law effects. Growing awareness of limited energy resources and concern for a sustainable economy have made it necessary to perform more refined thermodynamics studies, which required a realistic assessment of the degradation of energy due to irreversibilities. Such a necessity has made exergy efficiency an indispensable tool for performance evaluation.

This book primarily covers energy and exergy efficiencies and their associated discussion, and provides the necessary tools to analyze various systems and applications and to make comparisons. Coverage of the material is extensive, and the amount of information and data presented is sufficient for detailed studies. This book should be of interest to students, researchers, engineers, and practitioners in the area of energy as well as people who are interested in evaluating and improving energy systems and applications. The book should also serve as a valuable reference and source book for anyone who wishes to learn more about efficiency assessment.

The first chapter addresses general aspects of energy, efficiency, environment, and sustainable development as well as linkages between them with some examples. Chapter 2 introduces both the first and second laws of thermodynamics and discusses their role and use in practical applications. Chapter 3 goes further and introduces both energy and exergy efficiencies as valuable tools for performance evaluations and illustrates their use through some examples. It also puts these efficiencies in perspective, and highlights the differences between them. Chapter 4 deals specifically with energy conversion efficiencies and introduces

basic formulations for use in common applications. Chapter 5 presents thermodynamic modeling of power plants and their performance assessment using both energy and exergy efficiencies. Finally, analysis and performance assessment is extended in Chap. 6 to refrigeration systems, again through energy and exergy efficiencies. Incorporated throughout this book is a wide range of examples from a diverse area of practical applications.

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