Heat exchangers are a crucial part of aerospace, marine, cryogenic, and refrigeration technology. These essays cover such topics as complicated flow arrangements, complex extended surfaces, two-phase flow and irreversibility in heat exchangers, and single-phase heat transfer.

This book presents a wide-ranging review of the latest research and development directions in thermal systems optimization using population-based metaheuristic methods. It helps readers to identify the best methods for their own systems, providing details of mathematical models and algorithms suitable for implementation. To reduce mathematical complexity, the authors focus on optimization of individual components rather than taking on systems as a whole. They employ numerous case studies: heat exchangers; cooling towers; power generators; refrigeration systems; and others. The importance of these subsystems to real-world situations from internal combustion to air-conditioning is made clear. The thermal systems under discussion are analyzed using various metaheuristic techniques, with comparative results for different systems. The inclusion of detailed MATLAB codes in the text will assist readers, research engineers, practitioners or students to assess these techniques for different real-world systems. Thermal System Optimization is a useful tool for thermal design researchers and engineers in industry and academia, wishing to perform thermal system identification with properly optimized parameters. It will be of interest for researchers, practitioners and graduate students with backgrounds in mechanical, chemical, and power engineering.

The book presents a series of articles devoted to modeling, simulation, and optimization of processes, mainly chemical. General methods for process modeling and numerical simulation are described with flowsheeting. Population balances are addressed in detail with application to crystal production; energy saving is frequently optimized, including exergy analysis. The coupling between process simulation and computational fluid dynamics is studied for air classification and bubble columns. Pressure swing adsorption, reactive distillation, and nanofiltration are explained in general and applied to particular processes. The synthesis of carbon dots is solved by the design of experiments method. A safety study addresses the consequences of gas explosion.

This book is a unique, multidisciplinary effort to apply rigorous thermodynamics fundamentals, a disciplined scholarly approach, to problems of sustainability, energy, and resource use. Applying thermodynamic thinking to problems of sustainable behavior is a significant advantage in bringing order to ill-defined questions with a great variety of proposed solutions, some of which are more destructive than the original problem. The articles are pitched at a level accessible to advanced undergraduates and graduate students in courses on sustainability, sustainable engineering, industrial ecology, sustainable manufacturing, and green engineering. The timeliness of the topic, and the urgent need for solutions make this book attractive to general readers and specialist researchers as well. Top international figures from many disciplines, including engineers, ecologists, economists, physicists, chemists, policy experts and industrial ecologists among others make up the impressive list of contributors.

Design of Thermal Energy Systems Pradip Majumdar, Northern Illinois University, USA A comprehensive introduction to the design and analysis of thermal energy systems Design of Thermal Energy Systems poses the fundamentals and applications in thermal energy systems and components, including conventional power generation and cooling systems, renewable energy systems, heat recovery systems, heat sinks and thermal management. Practical examples are used throughout and are drawn from solar energy systems, fuel cell and battery thermal management, electrical and electronics cooling, engine exhaust heat and emissions, and manufacturing processes. Recent research topics such as steady and unsteady state simulation and optimization methods are also included. Key features: Provides a comprehensive introduction to the design and analysis of thermal energy systems, covering fundamentals and applications. Includes a wide range of industrial application problems and worked out example problems. Applies thermal analysis techniques to generate design specification and optimal solutions. Demonstrates how to design thermal systems and components to meet engineering specifications. Considers alternative options and allows for the estimation of cost and feasibility of thermal systems. Accompanied by a website including software for design and analysis, a solutions manual, and presentation files with PowerPoint slides. The book is essential reading for: practicing engineers in energy and power industries; consulting engineers in mechanical, electrical and chemical engineering; and senior undergraduate and graduate engineering students.

Composed of papers written by leading engineers and scientists in the field, this valuable collection reports the most recent advances in cryocooler development, contains
extensive performance test results and comparisons, and relates the latest experience in integrating cryocoolers into advanced applications.

The Exergy Method of Thermal Plant Analysis aims to discuss the history, related concepts, applications, and development of the Exergy Method—analysis technique that uses the Second Law of Thermodynamics as the basis of evaluation of thermodynamic loss. The book, after an introduction to thermodynamics and its related concepts, covers concepts related to exergy, such as physical and chemical exergy, exergy concepts for a control method and a closed-system analysis, the exergy analysis of simple processes, and the thermocentric applications of exergy. A seven-part appendix is also included. Appendices A-D covers miscellaneous information on exergy, and Appendix E features charts of thermodynamic properties. Appendix F is a glossary of terms, and Appendix G contains the list of references. The text is recommended for physicists who would like to know more about the Exergy Method, its underlying principles, and its applications not only in thermal plant analysis but also in certain areas.

The main scope of this study is to emphasize exergy efficiency in all fields of industry. The chapters collected in the book are contributed by invited researchers with a long-standing experience in different research areas. I hope that the material presented here is understandable to a wide audience, not only energy engineers but also scientists from various disciplines. The book contains seven chapters in three sections: (1) "General Information about Exergy,\(^{\text{1}}\) (2) "Exergy Applications,\(^{\text{2}}\) and (3) "Thermoeconomic Analysis.\(^{\text{3}}\) This book provides detailed and up-to-date evaluations in different areas written by academics with experience in their fields. It is anticipated that this book will make a scientific contribution to exergy workers, researchers, academics, PhD students, and other scientists in both the present and the future.

This publication, Our Fragile World: Challenges and Opportunities for Sustainable Development, presents opportunities for several important subjects that are covered in greater detail and depth in the Encyclopedia of Life Support Systems (EOLSS). The contributions to the two volumes provide an integrated presentation of knowledge and worldviews related to the state of: Earth's natural resources, social resources, institutional resources, and economic and financial resources. They present the vision and thinking of over 200 authors in support of efforts to solve the complex problems connected with sustainable development, and to secure perennial life support on "The Blue Planet". These contributions are holistic, informative, forward looking, and will be of interest to a broad readership. This volume presents contributions with focus on the Natural and Social Dimensions of sustainable development in two sections: NATURAL SYSTEMS AND RESOURCES (Natural Systems and Climate Change; - Natural Resources Management). - SOCIO-CULTURAL ISSUES (Human Security, Peace, and Socio-Cultural issues; Equity and Ethical issues).

This volume provides a systematic framework for energy suppliers, policy makers, academics, students, and all others interested in energy security, and analyzes key issues concerning energy, security and sustainability with the help of a wealth of data. While sustainability is the broadest objective, energy security is an important part of it, at the national, global and societal levels. The development of a sustainable, long-term solution to meeting the world's energy needs is a defining issue of our time, since central global challenges that the world faces—poverty alleviation, climate change, and environmental degradation—are directly linked to energy security. The contributions cover key issues concerning energy and energy security and illustrate that these are factors which have more to do with market forces, inefficient technologies, lack of institutions, environmental insecurity, pricing mechanisms, etc., and less to do with the international situation. The links between energy and development are both direct and indirect. Directly, energy provides several services and utilities to maintain human well-being, and also does so indirectly through stakeholders. This volume addresses both the direct and indirect links and provides sustainable alternatives, helping readers to better grasp the resilience of both socio-economic and resource sub-systems in the process. The issues affecting energy supply and demand, including technology portfolios, environmental considerations and consumer attitudes are thoroughly discussed. One of the critical questions that arises is how to facilitate energy investment. The investment climate and the key issues involved are analyzed, including: the capital flows with reasonable and stable investment frameworks, timely decision-making by governments, and open markets. The broad objective of the volume is to foster a deeper understanding of the concept of energy security and to identify the methods of analysis, policy initiatives and future research needed to generate a balanced pattern of energy use and mitigate its impact on humanity and the environment.

An examination of systematic techniques for the design of sustainable processes and products, this book covers reducing energy consumption, preventing pollution, developing new pathways for biofuels, and producing environmentally friendly and high-quality products. It discusses innovative design approaches and technological pathways that impact energy and environmental issues of new and existing processes. Highlights include design for sustainability and energy efficiency, emerging technologies and processes for energy and the environment, design of biofuels, biological processes and biorefineries, energy systems design and alternative energy sources, multi-scale systems uncertain and complex systems, and product design.
This open access book discusses the energy management for the multi-energy maritime grid, which is the local energy network installed in harbors, ports, ships, ferries, or vessels. The grid consists of generation, storage, and critical loads. It operates either in grid-connected or in islanding modes, under the constraints of both power system and transportation system. With full electrification, the future maritime grids, such as all-electric ships and seaport microgrids, will become “marine multi-energy system” with the involvement of multiple energy, i.e., electrical power, fossil fuel, and heating/cooling power. With various practical cases, this book provides a cross-disciplinary view of the green and sustainable shipping via the energy management of maritime grids. In this book, the concepts and definitions of the multi-energy maritime grids are given after a comprehensive literature survey, and then the global and regional energy efficiency policies for the maritime transportation are illustrated. After that, it presents energy management methods under different scenarios for all-electric ships and electrified ports. At last, the future research roadmap are overviewed. The book is intended for graduate students, researchers, and professionals who are interested in the energy management of maritime transportation.

Discover a straightforward and holistic look at energy conversion and conservation processes using the exergy concept with this thorough text. Explains the fundamental energy conversion processes in numerous diversified systems, ranging from jet engines and nuclear reactors to human bodies. Provides examples for applications to practical energy conversion processes and systems that use our naturally occurring energy resources, such as fossil fuels, solar energy, wind, geothermal, and nuclear fuels. With more than one-hundred diverse cases and solved examples, readers will be able to perform optimizations for a cleaner environment, a sustainable energy future, and affordable energy generation. An essential tool for practicing scientists and engineers who work or do research in the area of energy and exergy, as well as graduate students and faculty in chemical engineering, mechanical engineering and physics.

Bridging the gap between concepts derived from Second Law of Thermodynamics and their application to Engineering practice, the property exergy and the exergy balance can be a tool for analyzing and improving the performance of energy conversion processes. With the exergy analysis it is possible to evaluate the performance of energy conversion processes not only on a thermodynamics basis but also by including production costs and environmental aspects and impacts of the studied processes. This comprehensive approach of the use of energy has, as one of the most important feature, the identification of sustainable ways of energy resources utilization. Based on the fundamentals of the exergy concept, its calculation, graphical representations and exergy balances evaluation. Exergy: Production Cost And Renewability describes the application of detailed exergy and thermo-economic analysis to power plants and polygeneration systems, petroleum production and refining plants (including hydrogen production), chemical plants, biofuel production routes, combined production of ethanol and electricity, aircraft systems design, environmental impact mitigation processes and human body behavior. The presented case studies aim at providing students, researchers and engineers with guidelines to the utilization of the exergy and thermo-economic analysis to models, simulate and optimize real processes and industrial plants.

From engineering fluid mechanics to power systems, information coding theory and processes, entropy is key to maximizing performance in engineering systems. It serves a vital role in thermodynamic modeling of a large number of devices and systems, ranging from jet engines and nuclear reactors to human bodies. Provides examples for applications to practical energy conversion processes and systems that use our naturally occurring energy resources, such as fossil fuels, solar energy, wind, geothermal, and nuclear fuels. With more than one-hundred diverse cases and solved examples, readers will be able to perform optimizations for a cleaner environment, a sustainable energy future, and affordable energy generation. An essential tool for practicing scientists and engineers who work or do research in the area of energy and exergy, as well as graduate students and faculty in chemical engineering, mechanical engineering and physics.

This special issue addresses the general problem of a proper match between the demands of energy users and the units for energy conversion and storage, by means of proper design and operation of the overall energy system configuration. The focus is either on systems including single plants or groups of plants, connected or not to one or more energy distribution networks. In both cases, the design and operation involve decisions about thermodynamic processes, about the type, number, design parameters of components/plants, and storage capacities, and about mutual interconnections and the interconnections with the distribution grids. The problem is absolutely general, encompassing design and operation of energy systems for single houses, groups of houses, communities, industrial districts, municipal areas, regions and countries. The presented papers show that similar approaches can be used in different applications, although a general standard has not been achieved yet.

An essential resource for optimizing energy systems to enhance design capability, performance and sustainability. Optimization of Energy Systems comprehensively describes the thermodynamic modelling, analysis and optimization of numerous types of energy systems in various applications. It provides a new understanding of the system and the process of defining proper objective functions for determination of the most suitable design parameters for achieving enhanced efficiency, cost effectiveness and sustainability. Beginning with a presentation of the thermodynamic optimization techniques and optimization methods for thermal components, the book goes on to describe how to determine the most appropriate design parameters for more complex energy systems using various optimization methods. The results of each chapter provide potential tools for design, analysis, performance improvement, and greenhouse gas emissions reduction. Key features: Comprehensive coverage of the modelling, analysis and optimization of many energy systems for a variety of applications. Examples, practical applications and case studies to put theory into practice. Study problems at the end of each chapter that foster critical thinking and skill development. Written in an easy-to-follow style, starting with simple systems and moving to advanced energy systems and their complexities. A unique resource for undergraduate and graduate students in the thermodynamic analysis and optimization of energy systems. Optimization of Energy Systems is suitable for graduate and senior undergraduate students, researchers, engineers, practitioners, and scientists in the area of energy systems.

Exergy, Energy System Analysis, and Optimization theme is a component of the Encyclopedia of Energy Sciences, Engineering and Technology Resources which is part of the global Encyclopedia of Life Support Systems (EOLSS), an integrated compendium of twenty one Encyclopedias. These three volumes are organized into five different topics which represent

Design and Performance Optimization of Renewable Energy Systems provides an integrated discussion of issues relating to renewable energy performance design and optimization using advanced thermodynamic analysis with modern methods to configure major renewable energy plant configurations (solar, geothermal, wind, hydro, PV). Vectors of performance enhancement reviewed include thermodynamics, heat transfer, exergoeconomics and neural network techniques. Source technologies studied range across geothermal power plants, hydropower, solar power towers, linear concentrating PV, parabolic trough solar collectors, grid-tied hybrid solar PV/Fuel cell for freshwater production, and wind energy systems. Finally, nanofluids in renewable energy systems are reviewed and discussed from the heat transfer enhancement perspective. Reviews the Fundamentals of thermodynamics and heat transfer concepts to help engineers overcome design challenges for performance maximization. Explores advanced design and operating principles for solar, geothermal and wind energy systems with diagrams and examples. Combines detailed mathematical modeling with relevant computational analyses, focusing on novel techniques such as artificial neural network analyses. Demonstrates how to maximize overall system performance by achieving synergies in equipment and component efficiency.

During the last two decades many research and development activities related to energy have concentrated on efficient energy use and energy savings and conservation. In this regard, Thermal Energy Storage (TES) systems can play an important role, as they provide great potential for facilitating energy savings and reducing environmental impact. Thermal storage has received increasing interest in recent years in terms of its applications, and the enormous potential it offers both for more effective use of thermal equipment and for economic, large-scale energy substitutions. Indeed, TES appears to provide one of the most advantageous solutions for correcting the mismatch that often occurs between the supply and demand of energy. Despite this increase in attention, no book is currently available which comprehensively covers TES. Presenting contributions from prominent researchers and scientists, this book is primarily concerned with TES systems and their applications. It begins with a brief summary of general aspects of thermodynamics, fluid mechanics and heat transfer, and then goes on to discuss energy storage technologies, environmental aspects of TES, energy and exergy analyses, and practical applications. Furthermore, this book provides coverage of the theoretical, experimental and numerical techniques employed in the field of thermal storage. Numerous case studies and illustrative examples are included throughout. Some of the unique features of this book include: * State-of-the-art descriptions of many facets of TES systems and applications * In-depth coverage of exergy analysis and thermodynamic optimization of TES systems * Extensive new material on TES technologies, including advances due to innovations in sensible- and latent-energy storage * Key chapters on environmental issues, sustainable development and energy savings * Extensive coverage of practical aspects of the design, evaluation, selection and implementation of TES systems * Wide coverage of TES-system modelling, ranging in level from elementary to advanced * Abundant design examples, case studies and references In short, this book forms a valuable reference resource for practicing engineers and researchers, and a research-oriented text book for advanced undergraduate and graduate students of various engineering disciplines. Instructors will find that its breadth and structure make it an ideal core text for TES and related courses.

The transition towards renewable energy sources and “green” technologies for energy generation and storage is expected to mitigate the climate emergency in the coming years. However, in many cases, this progress has been hampered by our dependency on fossil and other resources that are often processed at high environmental burdens. Yet, many studies have shown that environmental and energy issues are strictly interconnected and require a comprehensive understanding of resource management strategies and their implications. Life cycle assessment (LCA) is among the most inclusive analytical techniques to analyze sustainability benefits and trade-offs within complex systems and, in this Special Issue, it is applied to assess the mutual influences of environmental and energy dimensions. The selection of original articles, reviews, and case studies addressed covers some of the main driving applications for energy requirements and greenhouse gas emissions, including power generation, bioenergy, biorefinery, building, and transport and related end-use sectors. Moreover, a perspective on the current status of, and trends in LCA, is presented. This Special Issue is intended to provide a comprehensive and accessible overview of the field, including the following topics: LCA, exergoeconomics, artificial neural network techniques. This book has been written to allow to achieve this aim. "Chairman of the Judges Award" from IChemE 2003

This book introduces readers to the “Jaya” algorithm, an advanced optimization technique that can be applied to many physical and engineering systems. It describes the algorithm, discusses its differences with other advanced optimization techniques, and examines the applications of versions of the algorithm in mechanical, thermal, manufacturing, electrical, computer, civil and structural engineering. In real complex optimization problems, the number of parameters to be optimized can be very large and their influence on the goal function can be very complicated and nonlinear in character. Such problems cannot be solved using classical methods and advanced optimization methods need to be applied. The Jaya algorithm is an algorithm-specific parameter-less algorithms that builds on other advanced optimization techniques. The application of Jaya in several engineering disciplines is critically assessed and its success compared with other complex optimization techniques such as Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Differential Evolution (DE), Artificial Bee Colony (ABC), and other recently developed algorithms.

This book contains state-of-the-art contributions in the fields of evolutionary and deterministic methods for design, optimization and control in engineering and sciences.
Specialists have written each of the 34 chapters as extended versions of selected papers presented at the International Conference on Evolutionary and Deterministic Methods for Design, Optimization and Control with Applications to Industrial and Societal Problems (EUCOMEN 2013). The conference was one of the Thematic Conferences of the European Community on Computational Methods in Applied Sciences (ECCOMAS). Topics treated in the various chapters include: theoretical and numerical methods and tools for optimization (theoretical methods and tools; numerical methods and tools) and engineering design and societal applications (turbo machinery; structures; materials and civil engineering; aeronautics and astronautics; societal applications; electrical and electronics applications), focused particularly on intelligent systems for multidisciplinary design optimization (mdo) problems based on multi-hybridized software, adjoint-based and one-shot methods, uncertainty quantification and optimization, multidisciplinary optimization, surrogate models based optimization methods in aerodynamic design.

This book deals with exergy and its applications to various energy systems and applications as a potential tool for design, analysis and optimization, and its role in minimizing and/or eliminating environmental impacts and providing for sustainable development. The ability of thermal energy storage (tes) systems to facilitate energy savings, renewable energy use and reduce environmental impact has led to a recent resurgence in their interest. The second edition of this book offers up-to-date coverage of recent energy efficient and sustainable technological methods and solutions, covering design, analysis, performance improvement as well as life-cycle costing and assessment. As well as having significantly revised the book for use as a graduate text, the authors address real-life technical and operational problems, enabling the reader to gain an understanding of the fundamental principles and practical applications of thermal energy storage technology. Beginning with a general summary of thermodynamics, fluid mechanics and heat transfer, this book goes on to discuss practical applications with chapters that include tes systems, environmental impact, energy savings, energy and exergy analyses, numerical modeling and simulation, case studies and new techniques and performance assessment methods.

Mechanical Engineering, Energy Systems and Sustainable Development theme is a component of Encyclopedia of Life Support Systems (EOLSS), which is an integrated compendium of twenty one Encyclopedias. The Theme on Mechanical Engineering, Energy Systems and Sustainable Development with contributions from distinguished experts in the field discusses mechanical engineering – the generation and application of heat and mechanical power and the design, production, and use of machines and tools. These five volumes are aimed at the following five major target audiences: University and College Students Educators, Professional Practitioners, Research Personnel and Policy Analysts, Managers, and Decision Makers, NGOs and GOs.

This thorough and highly relevant volume examines exergy, energy and the environment in the context of energy systems and applications and as a potential tool for design, analysis, optimization. It further considers their role in minimizing and/or eliminating environmental impacts and providing for sustainable development. In this regard, several key topics ranging from the basics of the thermodynamic concepts to advanced exergy analysis techniques in a wide range of applications are covered.

A comprehensive and rigorous introduction to thermal system design from a contemporary perspective Thermal Design and Optimization offers readers a lucid introduction to the latest methodologies for the design of thermal systems and emphasizes engineering economics, system simulation, and optimization methods. The methods of exergy analysis, entropy generation minimization, and thermoeconomics are incorporated in an evolutionary manner. This book is one of the few sources available that addresses the recommendations of the Accreditation Board for Engineering and Technology for new courses in design engineering. Intended for classroom use as well as self-study, the text provides a review of fundamental concepts, extensive reference lists, end-of-chapter problem sets, helpful appendices, and a comprehensive case study that is followed throughout the text. Contents include: * Introduction to Thermal System Design * Thermodynamics, Modeling, and Design Analysis * Exergy Analysis * Heat Transfer, Modeling, and Design Analysis * Applications with Heat and Fluid Flow * Applications with Thermodynamics and Heat and Fluid Flow * Economic Analysis * Thermoeconomic Analysis and Evaluation * Thermoeconomic Optimization Thermal Design and Optimization * Introduction to Engineering Design and Optimization * Conclusions. This forward-thinking book aligns itself with an increasing number of active designers who believe that moreeffective, system-oriented design methods are needed. Thermal Design and Optimization offers a lucid presentation of thermodynamics, heat transfer, and fluid mechanics as they are applied to the design of thermal systems. This book broadens the scope of engineering design by placing a strong emphasis on the interconnections between the fields. Without knowledge of the principles, it is impossible to produce designs that are not in conflict with each other, and this book introduces practical applications with chapters that include tesa systems, environmental impact, energy savings, energy and exergy analyses, numerical modeling and simulation, case studies and new techniques and performance assessment methods.

Thermal Design and Optimization is one of the few sources available that addresses the recommendations of the Accreditation Board for Engineering and Technology for more design emphasis in engineering curricula. Supported by extensive reference lists, end-of-chapter problem sets, and helpful appendices, this book is a superb text for both thermoclassroom and self-study, and for use in industrial design, development, and research. A detailed solutions manual is available from the publisher.

This book illustrates the editors’ application of a scientific principle, the second law of thermodynamics, for aerospace engineering. It discusses how they applied this law to advanced aerospace systems analysis and design optimization. It also discusses their research program which incorporates a systematic theoretical basis for constructing the proper formulas quantifying exergy balance, development of new computational capabilities for calculating exergy destruction, and exploration of novel approaches for system-level design. Topics include: identification of the upper limits on engineering system performance using the second law of thermodynamics; design methodology integration with tools...
Quantifying exergy losses in the energy supply system of buildings reveals the potential for energy improvement, which cannot be discovered using conventional energy analysis. Thermoeconomics combines economic and thermodynamic analysis by applying the concept of cost (an economic concept) to exergy, as exergy is a thermodynamic property fit for this purpose, in that it combines the quantity of energy with its quality factor. Exergy Analysis and Thermoeconomics of Buildings applies exergy analysis methods and thermoeconomics to the built environment. The mechanisms of heat transfer throughout the envelope of buildings are analyzed from an exergy perspective and then to the building thermal installations, analyzing the different components, such as condensing boilers, absorption refrigerators, microcogeneration plants, etc., including solar installations and finally the thermal facilities as a whole. A detailed analysis of the cost formation process is presented, which has its physical roots firmly planted in the second law of thermodynamics. The basic principles and the rules of cost allocation, in energy units (exergy cost), in monetary units (exergoeconomic cost), and in CO2 emissions (exergoenvironmental cost), based on the so-called Exergy Cost Theory are presented and applied to thermal installations of buildings. Clear and rigorous in its exposition, Exergy Analysis and Thermoeconomics of Buildings discusses exergy analysis and thermoeconomics and the role they could play in the analysis and design of building components, either the envelope or the thermal facilities, as well as the diagnosis of thermal installations. This book moves progressively from introducing the basic concepts to applying them. Exergy Analysis and Thermoeconomics of Buildings provides examples of specific cases throughout this book. These cases include real data, so that the results obtained are useful to interpret the inefficiencies and losses that truly occur in actual installations; hence, the assessment of their effects encourages the manner to improve efficiency. Exergy analysis methods for the installation of building thermal facilities equipment components, including pipes, valves, heat exchangers, boilers and heat pumps helps readers determine the operational costs of heating and cooling building systems. Includes exergy analysis methods and thermoeconomics for the analysis of thermal installations, analyzing the different components, such as condensing boilers, absorption refrigerators, microcogeneration plants, etc., including solar installations and finally the thermal facilities as a whole. A detailed analysis of the cost formation process is presented, which has its physical roots firmly planted in the second law of thermodynamics. The basic principles and the rules of cost allocation, in energy units (exergy cost), in monetary units (exergoeconomic cost), and in CO2 emissions (exergoenvironmental cost), based on the so-called Exergy Cost Theory are presented and applied to thermal installations of buildings. Clear and rigorous in its exposition, Exergy Analysis and Thermoeconomics of Buildings discusses exergy analysis and thermoeconomics and the role they could play in the analysis and design of building components, either the envelope or the thermal facilities, as well as the diagnosis of thermal installations. This book moves progressively from introducing the basic concepts to applying them. Exergy Analysis and Thermoeconomics of Buildings provides examples of specific cases throughout this book. These cases include real data, so that the results obtained are useful to interpret the inefficiencies and losses that truly occur in actual installations; hence, the assessment of their effects encourages the manner to improve efficiency. Presently there is no single publication available which covers the topics related to photovoltaic (PV) or photovoltaic thermal (PV/T) technologies, thermal modelling, CO2 mitigation and carbon trading. This book disseminates the current knowledge in the fundamentals of solar energy, photovoltaic (PV) or photovoltaic thermal (PV/T) technologies, energy security and climate change and is aimed at undergraduate and postgraduate students and professionals. The main emphasis of the book is on the design, construction, performance and application of PV and PV/T from the electricity and thermal standpoint. Not topics covered in the book include: energy security of a nation, climate change, CO2 mitigation and carbon credit earned by using PV or PV/T technologies (Carbon Trading). This information will prove helpful in filling the gap between the researchers and professionals working on the application of photovoltaic and global climate change. It also covers economic, cost effective and sustainable aspects of photovoltaic technologies. The book gives a detailed history of the new technological developments in PV/T systems worldwide with system photographs and references and elaborates on the fundamentals of hybrid systems and their performances with thermal modelling. Energy and exergy analysis, techno-economic analysis and carbon trading are key chapters for research professionals. The book also includes important case studies to aid understanding of the subject for all readers.

A comprehensive assessment of the methodologies of thermodynamic optimization, exergy analysis and thermoeconomics, and their application to the design of efficient and environmentally sound energy systems. The chapters are organized in a sequence that begins with pure thermodynamics and progresses towards the blending of thermodynamics with other disciplines, such as heat transfer and cost accounting. Three methods of analysis stand out: entropy generation minimization, exergy (or availability) analysis, and thermoeconomics. The book reviews current directions in a field that is both extremely important and intellectually alive. Additionally, new directions for research on thermodynamics and optimization are revealed.