Aerogel Based Coating For Energy Efficient Building Envelopes


Structural Health Monitoring of Biocomposites, Fibre-Reinforced Composites and Hybrid Compositesprovides detailed information on failure analyses, mechanical and physical properties, structural health monitoring, durability and life prediction, modelling of damage processes of natural fiber, synthetic fibers, and natural/natural, and natural/synthetic fiber hybrid composites. It provides a comprehensive overview of new technologies currently under development in the design and monitoring of composite materials. The book is an essential reference for researchers, engineers, and students working in the field of composite materials.

This book is the proceedings of the International Conference on Power Engineering-2007. The fields of this book include power engineering and relevant environmental issues. The recent technological advances in power engineering and related areas are introduced. This book is valuable for researchers, engineers and students majoring in power engineering.

Covering the latest technologies, Nanotechnology in eco-efficient construction provides an authoritative guide to the role of nanotechnology in the development of eco-efficient construction materials and sustainable construction. The book contains a special focus on applications ranging from concrete and cement to nanotechnology-driven significant developments in concrete technologies. The new edition has 14 new chapters, including 3 new parts: Mortars and concrete-related applications; Applications for pavements and other structural materials; and Toxicity, safety handling and environmental impacts. Civil engineers requiring an understanding of eco-efficient construction materials, as well as researchers and architects within any field of nanotechnology, eco-efficient materials or the construction industry will find this updated reference to be highly valuable. A addresses issues such as toxicity and LCA aspects. New chapters covering safety handling on occupational exposure of nanoparticles and the assessment of personal exposure to airborne nanomaterials. Discusses the effects of adding nano-particles on the durability and on the properties of geopolymers.

Reflecting the rapid growth of nanotechnology research and the potential impact of the growing energy crisis, Energy Efficiency and Renewable Energy Through Nanotechnology provides comprehensive coverage of cutting-edge research in the energy-related fields of nanoscience and nanotechnology, which aim to improve energy efficiency and the generation of renewable energy. Energy Efficiency and Renewable Energy Through Nanotechnology thoroughly correlates, comprehensively way that makes it not only suitable as a desk reference for research, but also as a knowledge resource for the non-expert general public. Readers will find Energy Efficiency and Renewable Energy Through Nanotechnology useful in a variety of ways, ranging from the creation of energy policy, to energy research development, and to education in nanotechnology and its application to energy-related problems. It can also be used as a primary or supplementary textbook for energy-related courses for advanced undergraduate and graduate students.

Sustainable Engineering for Life Tomorrow examines the future of sustainable engineering and architecture. The contributors' analyses of sustainable solutions, such as wind and solar power, offer valuable insights for future policy-making, scholarship, and the management of energy-intensive facilities.

This book serves as a comprehensive resource on various traditional, advanced and futuristic material technologies for aerospace applications encompassing nearly 20 major areas. Each of the chapters addresses scientific principles behind processing and production, production details, equipment and facilities for industrial production, and finally aerospace application areas of these material technologies. The chapters are authored by pioneers of industrial aerospace material technologies. This book has a well-planned layout in 4 parts. The first part deals with primary metal and material processing, including nano manufacturing. The second part deals with materials characterization and testing methodologies and technologies. The third part addresses structural design. Finally, several advanced material technologies are covered in the fourth part. Some key advanced topics such as "Structural Design by ASIP", "Damage Mechanics-Based Life Prediction and Extension" and "Principles of Structural Health Monitoring" are dealt with at equal length as the traditional aerospace materials technology topics. This book will be useful to students, researchers and professionals working in the domain of aerospace materials.

This book gathers the latest advances, innovations, and applications in the field of energy, environmental and construction engineering, as presented by international researchers and engineers at the International Scientific Conference Energy, Environmental and Construction Engineering, held in St. Petersburg, Russia on November 19-20, 2019. It covers highly diverse topics, including BIM: bridges, roads and tunnels; building materials; energy efficient and green buildings; structural mechanics; fluid mechanics; measuring technologies; environmental management; power consumption management; renewable energy; smart cities; and waste management. The contributions, which were selected by means of a rigorous international peer-review process, highlight numerous exciting ideas that will spur novel research directions and foster multidisciplinary collaborations.

This handbook presents an authoritative account of the potential of advanced ceramics and composites in strategic applications.
**Energy Efficient Building Envelopes**

including defense, national security, aerospace, and energy security (especially nuclear energy). It highlights how their unique combination of superior properties such as low density, high strength, high elastic modulus, high hardness, high temperature capability, and excellent dimensional stability is utilized in technologies within these fields. The handbook is organized according to application type. It allows readers to learn about strategies that have been used in different fields and to transfer them to their own. The book addresses a wide variety of ceramics and their composites, including PZT ceramics, carbon nanotubes, aerogels, silica radomes, relaxor ferroelectrics, and many others.

Super-critical Fluid Technology for Energy and Environmental Applications covers the fundamental principles involved in the preparation and characterization of supercritical fluids (SCFs) used in the energy production and other environmental applications. Energy production from diversified resources — including renewable materials — using clean processes can be accomplished using technologies like SCFs. This book is focused on critical issues scientists and engineers face in applying SCFs to energy production and environmental protection. The innovative solutions they have found, and the challenges they need to overcome. The book also covers the basics of supercritical fluids, phase behavior, and chemical equilibria, mathematical modeling, and process calculations. A supercritical fluid is any substance at a temperature and pressure above its critical point where distinct liquid and gas phases do not exist. At this state the compound demonstrates unique properties, which can be "fine-tuned," making them suitable as organic solvents in a range of industrial and laboratory processes. This volume enables readers to select the most appropriate medium for a specific application. It helps instructors prepare course material for graduate and postgraduate courses in the area of chemistry, chemical engineering, and environmental engineering. And it helps professional engineers learn supercritical fluid-based technologies and use them in solving the increasingly challenging environmental issues. Relates theory, chemical characteristics, and properties of the particular supercritical fluid to its various applications. Covers the fundamentals of supercritical fluids, like thermodynamics of phase and chemical equilibria, mathematical modeling, and process calculations. Includes the most recent applications of supercritical fluids, including energy generation, materials synthesis, and environmental protection.

**Nanocarbon and its Composites: Preparation, Properties and Applications** provides a detailed and comprehensive review of all major innovations in the field of nanocarbon and its composites, including preparation, properties and applications. Covering an extensive and quite extensive, encouraging future research in carbon-based materials, which are in high demand due to the need to develop more sustainable, recyclable and eco-friendly methods for materials. Chapters are written by eminent scholars and leading experts from around the globe who discuss the properties and applications of carbon-based materials, such as nanotubes (buckytubes), fullerences, cones, horns, foams, carbon fibers, and much more. Chapters provide cutting-edge, up-to-date research findings on the use of carbon-based materials in different application fields and illustrate how to achieve significant enhancements in physical, chemical, mechanical, and thermal properties. Demonstrates systematic approaches and investigations from design, synthesis, characterization and applications of nanocarbon based composites. Aims to compile information on the various aspects of synthesis, properties and applications of nano-carbon based materials. Presents a useful reference and technical guide for university academics and postgraduate students (Masters and Ph.D.).

The surface of textiles offers an important platform for functional modifications in order to meet special requirements for a variety of applications. The surface modification of textiles may be achieved by various techniques ranging from traditional solution treatment to biotechnological approaches. This book reviews fundamental issues relating to textile surfaces and their characterisation and explores the exciting opportunities for surface modification of a range of different textiles. Introductory chapters review important surface modification techniques employed for improved functional behaviour of textiles and the various surface characterisation methods available. Further chapters examine the different types of surface modification suitable for textiles, ranging from the use of plasma treatments and physical vapour deposition to the use of nanoparticles. Concluding chapters discuss surface modification strategies for various applications of textiles. Surface modification of textiles is a valuable resource for chemists, surface scientists, textile technologists, fibre scientists, textile engineers and textile students. Reviews fundamental issues relating to textiles surfaces and their characterisation examines various types of surface modification suitable for textiles, including plasma treatments and nanoparticles. Discusses surface modification strategies for textile applications such as expansion into technical textile applications.

This book presents a broad, general introduction to the processing of Sol-Gel technologies. This updated volume serves as a general handbook for researchers and students entering the field. This new edition provides updates in fields that have undergone rapid developments, such as Ceramics, Catalysis, Chromatography, Biomaterials, Glass Science, and Optics. It provides a simple, compact resource that can be used in graduate-level materials science courses.

This book presents the current state of knowledge on nanomaterials and their use in buildings, ranging from glazing and vacuum insulation to PCM composites. It also discusses recent applications in organic photovoltaics, bio-bioreactors, bioplastics and foams, making it an exciting read while also providing copious references to current research and applications for those wanting to pursue possible future research directions. Derek Clements-Croome, Emeritus Professor in Architectural Engineering, University of Reading. (From the Foreword) Demonstrating how higher energy efficiency in new and existing buildings can help reduce global greenhouse gas emissions, this book details the way in which new technologies, manufacturing processes and products can serve to abate emissions from the energy sector and offer a cost-effective means of improving competitiveness and drive employment. Maximising reader insights into how nano and biotech materials - such as aerogel based plasters, thermochromic glazings and thermal energy absorbing glass, amongst others - can provide high energy efficiency performance in buildings, it provides practitioners in the field with an important high-tech tool to tackle key challenges and is essential reading for civil engineers, architects, materials scientists and researchers in the area of the sustainability of the built environment.

The power consumption due to air-conditioning of buildings becomes particularly significant in an urban environment where the temperature of the air of dense urban districts is higher than in the suburbs. This phenomenon, as well as the increase in the standards of living and other factors namely heatwaves, contribute to the growth of the traditionally low demand for artificial air-conditioning in Europe. Case studies make it possible to measure the heat island effect (the accumulation of heat in cities), to characterize the additional electricity consumption of the buildings in an urban environment, and to give an overall picture of the practices, techniques and materials which can help to cool which avoid the need for artificial air-conditioning by taking into account the environment, the use of vegetation and "cool" materials for the construction of pavements and buildings. For the remaining needs for air-conditioning, the present systems of air-conditioning can also become more energy efficient. Case studies conducted in Seville made it possible to measure the dispersion of the needs for air-conditioning around their average value for the various zones of the city. One of the case studies evaluates the benefit associated with the systematic plantation of trees and other plants in Athens. Another case study relates to Paris and estimates the importance of centralized solutions for air-conditioning in an urban environment. This book results from a study launched by the European Commission and is written by authors from three European countries very concerned by heatwaves and their effects downtown: Greece (Athens), Spain (Seville) and France (Paris). All of them are professors or researchers in very high-level laboratories (Group Building Environmental Studies in Athens University, Energy Laboratory in Ecole des Mines de Paris and in Seville University).
This book shares the latest developments and advances in materials and processes involved in the energy generation, transmission, distribution and storage. Chapters are written by researchers in the energy and materials field. Topics include, but are not limited to, energy from biomass, bio-gas and bio-fuels; solar, wind, geothermal, hydro power, wave energy; energy-transmission, distribution and storage; energy-efficient lighting buildings; energy sustainability; hydrogen and fuel cells; energy policy for new and renewable energy technologies and education for sustainable energy development.

This book gives information and guidance on important subjects. It presents the major and efficient applications for efficient insulation materials. The book is divided into two parts. Part I discusses ecological insulation materials. In this part, the three sub-subjects are: drafting, unconventional insulation materials, and possible applications of Con Cob as a Raw Insulation Material. Part II: discusses practical applications, and performance of insulation materials (case studies), where the sub-subjects are: drafting, seismic aspects of the application of thermal insulation boards beneath the building's foundations, flammability of bio-based rigid polyurethane foam thermal insulation, and the review of some commonly used methods and techniques to measure the thermal conductivity of insulation materials.

Provided are polymer-aerogel composite coatings, devices and articles including polymer-aerogel composite coatings, and methods for preparing the polymer-aerogel composite. The exemplary article can include a surface, wherein the surface includes at least one region and a polymer-aerogel composite coating disposed over the at least one region, wherein the polymer-aerogel composite coating has a water contact angle of at least about 140 degree and a contact angle hysteresis of less than about 1 degree. The polymer-aerogel composite coating can include a polymer and an ultra-high water content catalyzed polysilicate aerogel, the polysilicate aerogel including a three dimensional network of silica particles having surface functional groups derivatized with a silylating agent and a plurality of pores.

This book focuses on aerogels and their applications in such areas as energy storage, thermal storage, catalysis, water splitting and environmental remediation. The materials covered include nanocellulose-, porous-, silica-, hybrid silica-, carbon-, graphene- and magnetic aerogels. Ways of modulating the pore structure of aerogels are presented, as well as surface modifications and the applications of coatings. Future perspectives focus on functional foods, thickeners, stabilizers, and scaffolding in tissue repair. Keywords: Aerogels, Nanocellulose Aerogels, Non-Silicate Aerogels, Organic Aerogels, Composite Hybrid Aerogels, Carbon-based and Graphene-based Aerogels, Biogels, Hybrid Silica-based Aerogels, Energy Storage, Thermal Storage, Catalysis, Water Splitting, Environmental Remediation, Absorbents, Gas Filters, Packaging Materials, Electrical Devices, Thermal Insulations, Fire Retardants, Pharmaceutical and Biomedical Applications, Functional Foods, Thickeners, Stabilizers, Scaffolding in Tissue Repair.

Today, the application of phase change materials (PCMs) has developed in different industries, including the solar cooling and solar power plants, photovoltaic electricity systems, the space industry, waste heat recovery systems, preservation of food and pharmaceutical products, and domestic hot water. PCMs use the principle of latent heat thermal storage to absorb energy in large quantities when there is a surplus and release it when there is a deficit. This promising technology has already been successfully implemented in many construction projects. The aim of this book is to assist the scientists and to provide the reader with a comprehensive overview of the properties that characterize the phase change materials from theoretical and experimental perspectives with a focus on their technological applications. The present status and future perspectives of phase change materials are discussed.

Advancements in polymer nanocomposite foams have led to their application in a variety of fields, such as automotive, packaging, and insulation. Employing nanocomposites in foam formation enhances their property profiles, enabling a broader range of uses, from conventional to advanced applications. Since many factors affect the generation of nanost
of energy in buildings, neighbourhoods and cities from a theoretical, practical, implementation and simulation perspective. The conference formed an exciting chance to present, interact, and learn about the latest research and practical developments on the subject. The conference attracted submissions from around the world. Submissions for the Full-Paper Track were subjected to a blind peer-review process. Only the best of these were selected for presentation at the conference and publication in these proceedings. It is intended that this volume provides a useful and informative snapshot of recent research developments in the important and vibrant area of Sustainability in Energy and Buildings.

Environmental problems derived from the massive use of conventional energy resources are one of the main issues that our society has been facing in recent decades. Renewable energies (and particularly solar energy) have become a highly competitive means to meet the world’s increasing energy demands in a sustainable and clean manner. One of the key research challenges for the commercial deployment of several solar energy technologies is focused on the development of feasible and durable coatings that withstand the appropriate optical and thermal performance over the lifetime of the solar facilities. This book addresses a number of relevant aspects related to coatings for renewable energies, including a detailed survey of coatings used in photovoltaic solar energy, the development of a superhydrophobic and thermal stable silica coating that is potentially suitable for various industrial applications related to renewable technologies, the development of coatings to improve the resistance of structural materials used in concentrating solar thermal technologies with molten salts, and several research works related to solar reflectors for concentrating solar thermal technologies (such as the advanced analysis of the corrosion, the suitability of anti-soiling coatings, and the development of top protective coatings for high-temperature secondary concentrators).

This book presents select proceedings of the international conference on Innovations in Clean Energy Technologies (ICET 2020) and examines a range of durable, energy efficient and next-generation smart green technologies for sustainable future by reflecting on the trends, advances, development taking place across the globe. The topics covered include smart technologies, energy efficient systems, solar and wind energy, carbon sequestration, green transportation, green buildings, energy material, biomass energy, smart cities, hydro power, bio-energy and fuel cell. The book also discusses various performance attributes of these clean energy technologies and their workability and carbon footprint. The book will be a valuable reference for beginners, researchers and professionals interested in clean energy technologies.

This book results from a Special Issue published in Energies, entitled “Building Thermal Envelope”. Its intent is to identify emerging research areas within the field of building thermal envelope solutions and contribute to the increased use of more energy-efficient solutions in new and refurbishment buildings. Its contents are organized in the following sections: Building envelope materials and systems envisaging indoor comfort and energy efficiency; Building thermal and energy modelling and simulation; Lab test procedures and methods of field measurement to assess the performance of materials and building solutions; Smart materials and renewable energy in building envelope; Aptive and intelligent building envelope; and Integrated building envelope technologies for high performance buildings and cities.

Aerogels are the lightest solids known. Up to 1000 times lighter than glass and with a density as low as only four times that of air, they show very high thermal, electrical and acoustic insulation values and hold many entries in Guinness World Records. Originally based on silica, R&D efforts have extended this class of materials to non-silicate inorganic oxides, natural and synthetic organic polymers, carbon, metal and cermets, polymer-crosslinked aerogels and interpenetrating polymer networks have been developed and exhibit remarkable mechanical strength and flexibility. Even more exotic aerogels based on clays, chalcogenides, phosphides, quantum dots, and biopolymers such as chitosan are opening new applications for the construction, transportation, energy, defense and healthcare industries. Applications in electronics, chemistry, mechanics, engineering, energy production and storage, sensors, medicine, nanotechnology, military and aerospace, oil and gas recovery, thermal insulation and household uses are being developed with an estimated annual market growth rate of around 70% until 2035. The Aerogels Handbook summarizes state-of-the-art developments and processing of inorganic, organic, and composite aerogels, including the most important methods of synthesis, characterization as well as their typical applications and their possible market impact. Readers will find an exhaustive overview of all aerogel materials known today, their fabrication, upscaling aspects, physical and chemical properties, and most recent advances towards applications and commercial products, some of which are currently available today. Key Features: Edited and written by recognized worldwide leaders in the field • Appeals to a broad audience of materials scientists, chemists, and engineers in academic research and industrial R&D • Covers inorganic, organic, and composite aerogels • Describes military, aerospace, building industry, household, environmental, energy, and biomedical applications among others

This essential handbook provides comprehensive coverage of the current state-of-the-art in inorganic, organic, and composite aerogels, from synthesis and characterization through the latest applications and their possible market impact. Based on the successful Aerogels Handbook published in 2011, this book has been extensively revised and updated to reflect the changes in this fast-growing field. Aerogels are the lightest solids known to man. Up to 1000 times lighter than glass and with a density as low as only four times that of air, they possess exceedingly high thermal, electrical, and acoustic insulation properties, and hold many entries in Guinness World Records. Originally based on silica, R&D efforts have extended this class of materials to incorporate non-silicate inorganic oxides, natural and synthetic organic polymers, carbon, metal, and ceramic materials. Composite systems involving polymer-crosslinked aerogels and interpenetrating hybrid networks have been developed and exhibit remarkable mechanical strength and flexibility. Even more exotic aerogels based on clays, chalcogenides, phosphides, quantum dots, and biopolymers such as chitosan are opening new applications for the construction, transportation, energy, defense and healthcare industries. Applications in electronics, chemistry, mechanics, engineering, energy production and storage, sensors, medicine, nanotechnology, military and aerospace, oil and gas recovery, thermal insulation, and household uses are being developed. Readers of this fully updated and expanded edition will find an exhaustive source for all aerogel materials known today, their fabrication, upscaling aspects, physical and chemical properties, and the most recent advances towards applications and commercial use. This key reference represents essential reading for a combined audience of graduate students, practicing academics, and industry researchers.

Novel breakthroughs in the cutting-edge field of nanotechnology, as a cross-sectional technology, show potential for being applied across the whole value chain of the energy sector (energy sources, energy conversion, energy distribution, energy storage, and energy use). This book gives a detailed account of the value chain of the energy sector and evaluates selected applications and their direct and indirect impacts on the energy sector. It presents selected nanotechnological applications that influence the energy economy significantly. Furthermore, the authors give a comprehensive description of the impacts and outcomes of selected nanotechnological applications on energy consumption, energy sources, energy supply, and the energy industry in Germany and show the potential of these applications for energy savings, improvement in energy efficiency, and the reduction of emissions until 2030.

This book explores the improvement in thermal insulation properties of protein-based silica aerogel composites fabricated by a novel, inexpensive and feasible method. The resulting material exhibits polymeric foam behavior including high compressibility, superhydrophobic characteristics and excellent strain recovery in addition to low thermal conductivity. The fabrication methodologies are explained in great detail and represented in flowcharts for easy reference and understanding. This monograph gives readers a new perspective on
composite fabrication using methods other than the traditional ones and explores the endless ways of altering the composition to modify the properties of the silica aerogel composites. Applications for this novel composite are diverse and range from those in the pharmaceutical and aerospace industries to the oil and gas industries.

Semiannual, with semiannual and annual indexes. References to all scientific and technical literature coming from DOE, its laboratories, energy centers, and contractors. Includes all works deriving from DOE, other related government-sponsored information, and foreign nonnuclear information. Arranged under 39 categories, e.g., Biomedical sciences, basic studies; Biomedical sciences, applied studies; Health and safety; and Fusion energy. Entry gives bibliographical information and abstract. Corporate, author, subject, report number indexes.

BioPolymers could be either natural polymers - polymer naturally occurring in Nature, such as cellulose or starch…, or biobased polymers that are artificially synthesized from natural resources. Since the late 1990s, the polymer industry has faced two serious problems: global warming and anticipation of limitation to the access to fossil resources. One solution consists in the use of sustainable resources instead of fossil-based resources. Hence, biomass feedstocks are a promising resource and biopolymers are one of the most dynamic polymer areas. Additionally, biodigesterability is a special functionality conferred to a material, bio-based or not. Very recently, facing the awareness of the volumes of plastic wastes, biodegradable polymers are gaining increasing attention from the market and industrial community. This special issue of Molecules deals with the current scientific and industrial challenges of Natural and Biobased Polymers, through the access of new biobased monomers, improved thermo-mechanical properties, and by substitution of harmful substances. This themed issue can be considered as collection of highlights within the field of Natural Polymers and Biobased Polymers which clearly demonstrate the increased interest in this field. We hope that this will inspire researchers to further develop this area and thus contribute to futures more sustainable society:"

Aerogels have been in use for over 80 years and have been utilized in a wide variety of applications, in particular, there has been growing use of insulating nanoporous materials in the aerospace industry. Recent awareness of the environmental implications of materials has driven researchers to develop new green materials, with aerogels being developed using biobased constituents, such as polysaccharides and proteins. Recently, biobased components, such as cellulose nanocrystals, have replaced synthetic counterparts in the production of nanoporous materials. Biobased Aerogels is the first book to cover aerogel research from a green perspective, using commentary and analysis from leading researchers working in the field. Aerogels based on polysaccharides and proteins, their preparation and characterization will be covered in detail, with further discussion highlighting properties such as surface morphology, shape recovery, mechanical properties and adsorption capacity. This insightful and timely publication will provide essential reading for those researchers and industrialists working within the green chemistry field.

Geopolymers and zeolites as eco-friendly materials can participate in cutting-edge research and applications due to their tailored properties, including superabsorbent capacity, heavy metals encapsulation, flame retardancy, mechanical performance, electrophoretic behaviour, corrosion resistance, and thermal properties. This book joins activities and knowledge of researchers from multiple fields to present a comprehensive overview of the advances in synthesis and characterization of geopolymers and zeolites, including base chemistry concepts, nanoscale characterization, and applications in top-level industry.

Comprehensive Energy Systems provides a unified source of information covering the entire spectrum of energy, one of the most significant issues humanity has to face. This comprehensive book describes traditional and novel energy systems, from single generation to multi-generation, also covering theory and applications. In addition, it also presents high-level coverage on energy policies, strategies, environmental impacts and sustainable development. No other published work covers such breadth of topics in similar depth. High-level sections include Energy Fundamentals, Energy M atериалs, Energy Production, Energy Conversion, and Energy M anagement. Offers the most comprehensive resource available on the topic of energy systems Presents an authoritative resource authored and edited by leading experts in the field Consolidates information currently scattered in publications from different research fields (engineering as well as physics, chemistry, environmental sciences and economics), thus ensuring a common standard and language

Winner of Choice M agazine - Outstanding A cademic T itles for 2007 Buildings account for over one third of global energy use and associated greenhouse gas emissions worldwide. Reducing energy use by buildings is therefore an essential part of any strategy to reduce greenhouse gas emissions, and thereby lessen the likelihood of potentially catastrophic climate change. Bringing together a wealth of hard-to-obtain information on energy use and energy efficiency in buildings at a level which can be easily digested and applied, Danny Harvey offers a comprehensive, objective and critical sourcebook on low-energy buildings. Topics covered include: thermal envelopes, heating, cooling, heat pumps, HVAC systems, hot water, lighting, solar energy, appliances and office equipment, embodied energy, buildings as systems and community-integrated energy systems (cogeneration, district heating, and district cooling). The book includes exemplary buildings and techniques from North America, Europe and Asia, and combines a broad, holistic perspective with technical detail in an accessible and insightful manner.