A Life Cycle Analysis Model And Decision Support Tool For

The first book of its kind, the LCA Handbook will become an invaluable resource for environmentally progressive manufacturers and suppliers, product and process designers, executives and managers, and government officials who want to learn about this essential component of environmental sustainability.

Perspectives in Life Cycle Impact Assessment: A Structured Approach to Combine Models of the Technosphere, Ecosphere and Valuesphere describes the relationship between subjective and objective elements in Life Cycle Impact Assessment. It suggests a new framework which will allow people to master two of the major problems associated with LCA, the difficulty of separating subjective from objective elements and the tendency for impact assessment to record `phantoms' rather than actual damages. Perspectives in Life Cycle Impact Assessment: A Structured Approach to Combine Models of the Technosphere, Ecosphere and Valuesphere presents a proposal for a second generation framework and method for Life Cycle Impact Assessment. Many of the suggested elements are either based on other tools for environmental analysis, e.g. risk assessment, or fit in well with tools and concepts such as industrial ecology, technology assessment, or environmental impact assessment. The research presented in this book goes beyond the scope of presently used methods for Life Cycle Assessment and may stimulate new developments in a variety of areas. The book will appeal to persons from a wide range of scientific disciplines who are interested in learning more about Life Cycle Assessment. It will be especially valuable to members of SETAC and to students and researchers in the fields of environmental impact assessment, risk assessment and industrial ecology.

Life-cycle assessment is a methodology used to evaluate the environmental impacts of a product, process, or service during its life cycle, and risk assessment is a tool to evaluate potential hazards to human health and the environment introduced by pollutant emissions. The United Nations Sustainable Development Goals call for, among other objectives, responsible consumption and production by decoupling environmental resource use and environmental impacts from economic growth and human well-being. Life-cycle assessment and risk assessment are both analytical system approaches that allow scientists and other decision makers to address these issues and objectives according to the current understanding of environmental mechanisms. This book is the first attempt to illustrate the existing interfaces between life-cycle assessment and risk assessment and to indicate options for further integration of both tools. The second edition: Focuses on sustainability Considers new developments in life-cycle assessment and environmental risk assessment over the last ten years at the international level Introduces broader concepts and discussions on integrative versus the complementary use of life-cycle and risk assessments Extends the scope of integrated life-cycle and risk assessments to critical raw materials Includes more case studies and discusses engineered nanomaterials Featuring contributions from leading experts, Integrated Life-Cycle and Risk Assessment for Industrial Processes and Products is a great reference for graduate students and professionals in environmental management and intends to catalyze communication between life-cycle assessment and risk assessment experts and scientists in academia, industry, and governmental agencies. The practical format of the book—illustrated with flowcharts, examples, exercises, and concrete applications—makes it a useful manual for analyzing situations and making decisions.

Life-Cycle Assessment of Biorefineries, the sixth and last book in the series on biomass-biorefineries discusses the unprecedented growth and development in the emerging concept of a global bio-based economy in which biomass-based biorefineries have attained center stage for the production of fuels and chemicals. It is envisaged that by 2020 a majority of chemicals currently being produced through a chemical route will be produced via a bio-based route. Agro-industrial residues, municipal solid wastes, and forestry wastes have been considered as the most significant feedstocks for such bio-refineries. However, for the techno-economic success of such biorefineries, it is of prime and utmost importance to understand their lifecycle assessment for various aspects. Provides state-of-art information on the basics and fundamental principles of LCA for biorefineries Contains key features for the education and understanding of integrated biorefineries Presents models that are used to cope with land-use changes and their effects on biorefineries Includes relevant case studies that illustrate main points

Environmental life cycle assessment is often thought of as cradle to grave and therefore as the most complete accounting of the environmental costs and benefits of a product or service. However, as anyone who has done an environmental life cycle assessment knows, existing tools have many problems: data is difficult to assemble and life cycle studies take months of effort. A truly comprehensive analysis is prohibitive, so analysts are often forced to simply ignore many facets of life cycle impacts. But the focus on one aspect of a product or service can result in misleading indications if that aspect is benign while other aspects pollute or are otherwise unsustainable. This book summarizes the EIO-LCA method, explains its use in relation to other life cycle assessment models, and provides sample applications and extensions of the model into novel areas. A final chapter explains the free, easy-to-use software tool available on a companion website. (www.eiolca.net) The software tool provides a wealth of data, summarizing the current U.S. economy in 500 sectors with information on energy and materials use, pollution and greenhouse gas discharges, and other attributes like associated occupational deaths and injuries. The joint project of twelve faculty members and over 20 students working together over the past ten years at the Green Design Institute of Carnegie Mellon University, the EIO-LCA has been applied to a wide range of products and services. It will prove useful for research, industry, and in economics, engineering, or interdisciplinary classes in green design.

Environmental Life Cycle Assessment is a pivotal guide to identifying environmental problems and reducing related impacts for companies and organizations in need of life cycle assessment (LCA). LCA, a unique sustainability tool, provides a framework that addresses a growing demand for practical technological solutions. Detailing each phase of the LCA methodology, this textbook covers the historical development of LCA, presents the general principles and

characteristics of LCA, and outlines the corresponding standards for good practice determined by the International Organization for Standardization. It also explains how to identify the critical aspects of an LCA, provides detailed examples of LCA analysis and applications, and includes illustrated problems and solutions with concrete examples from water management, electronics, packaging, automotive, and other industries. In addition, readers will learn how to: Use consistent criteria to realize and evaluate an LCA independently of individual interests Understand the LCA methodology and become familiar with existing databases and methods based on the latest results of international research Analyze and critique a completed LCA Apply LCA methodology to simple case studies Geared toward graduate and undergraduate students studying environmental science and industrial ecology, as well as practicing environmental engineers, and sustainability professionals who want to teach themselves LCA good practices, Environmental Life Cycle Assessment demonstrates how to conduct environmental assessments for products throughout their life cycles. It presents existing methods and recent developments in the growing field of LCA and systematically covers goal and system definition, life cycle inventory, life cycle impact assessment, and interpretation.

Environmental policy aims at the transition to sustainable production and consumption. This is taking place in different ways and at different levels. In cases where businesses are continuously active to improve the environmental performance of their products and activities, the availability of knowledge on environmental impacts is indispensable. The integrated assessment of all environmental impacts from cradle to grave is the basis for many decisions relating to achieving improved products and services. The assessment tool most widely used for this is the environmental Life Cycle Assessment, or LCA. Before you is the new Handbook of LCA replacing the previous edition of 1992. New developments in LCA methodology from all over the world have been discussed and, where possible, included in this new Handbook. Integration of all developments into a new, consistent method has been the main aim for the new Handbook. The thinking on environment and sustainability is, however, quickly evolving so that it is already clear now that this new LCA Handbook does not embrace the very latest developments. Therefore, further revisions will have to take place in the future. A major advantage of this Handbook is that it now also advises which procedures should be followed to achieve adequate, relevant and accepted results. Furthermore, the distinction between detailed and simplified LCA makes this Handbook more broadly applicable, while guidance is provided as to which additional information can be relevant for specialised applications.

The trend in industry and with the EPA is to prevent wastes before they are created instead of treating or disposing of them later. This book assists design/systems engineers and managers in designing or changing a product or set of processes in order to minimize the negative impact on the environment during its life cycle. It explains the overall concept of environmental life cycle analysis and breaks down each of the stages, providing a clear picture of the issues involved. Chapters 1 and 2 provide an introduction and overview of the environmental life cycle analysis process. Chapter 3 establishes the basis and methodologies required for analysis through description of the basic framework, definition of boundaries, use of checklists, data gathering processes, construction of models, and interpretation of results. Templates and special cases that may be encountered and how to handle them are addressed in Chapter 4. Chapters 5 through 9 go into detail about modeling, issues, and data collection for each stage of the product life cycle. The final chapter provides a summary of the various steps and offers ideas on how to present data and reports.

Life Cycle Assessment (LCA) has developed in Australia over the last 20 years into a technique for systematically identifying the resource flows and environmental impacts associated with the provision of products and services. Interest in LCA has accelerated alongside growing demand to assess and reduce greenhouse gas emissions across different manufacturing and service sectors. Life Cycle Assessment focuses on the reflective practice of LCA, and provides critical insight into the technique and how it can be used as a problem-solving tool. It describes the distinctive strengths and limitations of LCA, with an emphasis on practice in Australia, as well as the application of LCA in waste management, the built environment, water and agriculture. Supported by examples and case studies, each chapter investigates contemporary challenges for environmental assessment and performance improvement in these key sectors. LCA methodologies are compared to the emerging climate change mitigation policy and practice techniques, and the uptake of ‘quick’ LCA and management tools are considered in the light of current and changing environmental agendas. The authors also debate the future prospects for LCA technique and applications.

As businesses face an increasing array of environmental challenges, including climate change, air and water pollution, and solid waste management, environmental management has become an increasingly important area of expertise. Elements of Environmental Management is an interdisciplinary textbook for students and business professionals that integrates corporate environmental strategy with environmental economics, environmental law, and environmental engineering. Written by Werner Antweiler, an expert on international trade and environmental economics, Elements of Environmental Management approaches environmental issues from a business perspective: How can businesses respond to public policies and regulatory requirements? How does emission trading work? What technological options are available to prevent or mitigate pollution? Using examples from a wide range of industries, Antweiler presents the essential tools for examining environmental problems from a business perspective.

This book introduces readers to Life Cycle Approach (LCA)-supported design solutions, through non-geometric-data-driven methodologies, to provide a clear picture of how to optimize individual designs in addressing ecological challenges. By offering LCA, the book gives designers a complimentary set of science-based perspectives and techniques with a focus on high data quality for clarity and public accessibility. While most design solutions and resources are meant to appeal to people by solving everyday problems, this book uses LCA designs to appeal to people through a combination of practicality, accuracy, and the need to decelerate ecological destruction through products offered to marketplace consumers. In essence, the book teaches designers how to craft environmentally responsive designs for their clients at little to no extra cost, but with necessary ecological benefits. The book analyzes the human desire for consumption, and suggests design innovations for promoting "best practices". LCA tools, data, and methodologies are explained and offered as these potential innovations for affecting positive environmental change. As an underlying component of LCA, the book defines the energy essentials related to environmental problems, and how LCA design solutions must address these factors while also appealing to a designated client-base. The book also teaches designers how to consider corporate incentives for trusting LCA designs, such as investor confidence, loyalty, and consumer trust. The book will appeal to a broad range of designers interested in sustainable and data-driven design, and may be utilized by non-LCA specialists in expanding their design perspectives and goals in the marketplace.

Global warming is the most severe environmental challenge faced by humanity today and the costs of responding effectively will be high. While Russia’s ratification of the Kyoto Protocol ensures the treaty’s entry into force, lack of capacity, or incentive

The purpose of this book is to collect a high-quality selection of contemporary research articles on life cycle perspectives when we want to assess and predict the sustainability of solutions that lie in front of us.The book focuses on methodologies and tools used for life cycle sustainability management covering environmental, social, and economic aspects in business practices, including modeling and simulation-based approaches. In particular, the book aims to collect research, applications, and case studies in the field of environmental analysis and industrial ecology, with a focus on how to assess contributions to increase resource efficiency and reduce environmental impact on production and service systems in a life cycle perspective (raw material extraction, production, use, and end-of-life management).This book is intended to be a useful resource for anyone who deals with this issue.

This volume contains the papers presented at IALCCE2018, the Sixth International Symposium on Life-Cycle Civil Engineering (IALCCE2018), held in Ghent, Belgium, October 28-31, 2018. It consists of a book of extended abstracts and a USB device with full papers including the Fazlur R. Khan lecture, 8 keynote lectures, and 390 technical papers from all over the world. Contributions relate to design, inspection, assessment, maintenance or optimization in the framework of life-cycle analysis of civil engineering structures and infrastructure systems. Life-cycle aspects that are developed and discussed range from structural safety and durability to sustainability, serviceability, robustness and resilience. Applications relate to buildings, bridges and viaducts, highways and runways, tunnels and underground structures, off-shore and marine structures, dams and hydraulic structures, prefabricated design, infrastructure systems, etc. During the IALCCE2018 conference a particular focus is put on the cross-fertilization between different sub-areas of expertise and the development of an overall vision for life-cycle analysis in civil engineering. The aim of the editors is to provide a valuable source of cutting edge information for anyone interested in life-cycle analysis and assessment in civil engineering, including researchers, practising engineers, consultants, contractors, decision makers and representatives from local authorities.

This book describes the methodology of life-cycle analysis of new energy solutions and their applications in a climate impact context.

This open access book summarizes research being pursued within the Manutelligence project, the goal of which is to help enterprises develop smart, social and flexible products with high value added services. Manutelligence has improved Product and Service Design by developing suitable models and methods, and connecting them through a modular, collaborative and secure ICT Platform. The use of real data collected in real time by Internet of Things (IoT) technologies underpins the design of product-service systems and makes it possible to monitor them throughout their life cycle. Available data allows costs and sustainability issues to be more accurately measured and simulated in the form of Life Cycle Cost (LCC) and Life Cycle Assessment (LCA). Analysing data from IoT systems and sharing LCC and LCA information via the ICT Platform can help to accelerate the design of product-service systems, reduce costs and better understand customer needs. Industrial partners involved in Manutelligence provide a clear overview of the project’s outcomes, and demonstrate how its technological solutions can be used to improve the design of product-service systems and the management of product-service life cycles.

This dissertation, "Life Cycle Analysis of Different Feedstocks of Biodiesel Production" by Chuan, Yu, ??, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. Abstract: ?The scarcity of fossil fuel and its environmental impact have shifted the world focus on green innovations At a time when the use of fossil fuel means increasing energy scarcity and an environmental crisis in the world in which we live, we need green innovations now more than ever. Growing attention has been drawn to the use of biofuels, such as bioethanol and biodiesel, which have gradually come to make up part of the total energy supply. Uncertainties about the environmental and ecological aspects of the production and consumption of biofuel still exist despite its rapid development. A life cycle analysis (LCA) evaluates the two principal functional parameters 1) energy efficiency and 2) Greenhouse Gas (GHG) balance of different feedstocks for biodiesel production from the cradle to the grave. By accounting a life cycle analysis stage by stage, we can ascertain the change in GHG emissions and energy demand that result from the various uses of feedstocks for the production of biodiesel. In this thesis, various life cycle analysis models are reviewed and evaluated with emphasis on specific biofuels. Different LCA models depend on different LCA calculation under different situations, including GREET, LEM, SimaPro, etc. The software SimaPro was used to compare the life cycle GHG emissions and energy demand from conventional petroleum fuels and several hydro-processed renewable green diesels. A consistent methodology was used for selected fuel pathways to facilitate relatively equitable comparisons. The building of life cycle flow tree in SimaPro combined the input and output with an emphasis on the following stages 1) raw material farming and acquisition, 2)liquid fuel production, 3)transport, 4)refueling, 5)liquid fuel conversion to biodiesel and 6) end uses. Consistent impact assessment methods were chosen for simulation, equitable comparisons and comprehensive analysis of selected fuel pathways for the calculation of Global Warming Potential (GWP) and Cumulative Energy Demand (CED). However, the results of the entire lifetime estimates vary dramatically in production chains, which make it difficult to take a holistic view about energy intake and yields, economic costs and values, environmental impacts and their benefits. Apart from the diversity in system boundaries and life cycle inventories, a variance in terminologies and the limitations of interdisciplinary communication are the main factors that affect the quality of the results. DOI: 10.5353/th_b4961802 Subjects: Biodiesel fuels - Environmental aspects Product life cycle - Environmental aspects

The Guidelines for Social Life Cycle Assessment of Products provides a map, a skeleton and a flash light for stakeholders engaging in the assessment of social and socio-economic impacts of products life cycle. The map describes the context, the key concepts, the broader field in which tools and techniques are getting developed and their scope of application. The skeleton presents key elements to consider and provide guidance for the goal and scope, inventory, impact assessment and interpretation phases of a social life cycle assessment. The flash light highlights areas where further research is needed. Social Life Cycle Assessment is a technique available to account for stories and inform systematically on impacts that otherwise would be lost in the vast and fast moving sea of our modern world. May it help stakeholders to effectively and efficiently engage to improve social and socio-economic conditions of production and consumption

Life Cycle Analysis of NanoparticlesReducing Risk and LiabilityDEStech Publications, Inc

Life Cycle Assessment for Sustainable Mining addresses sustainable mining issues based on life cycle assessment, providing a thorough guide to implementing LCAs using sustainability metrics. The book details current research on LCA methodologies related to mining, their outcomes, and how to relate sustainable mining concepts in a circular economy. It is an in-depth, foundational reference for developing ideas for technological advancement through designing reduced-emission mining equipment or processes. It includes literature reviews and theoretical concepts of life cycle assessments applied in mining industries, sustainability metrics and problems related to mining and mineral processing industries identified by the life cycle assessment results. This book will aid researchers, students and academics in the field of environmental science, mining engineering and sustainability to see LCA technology outcomes which would be useful for the future development of environmentally-friendly mining processes. Details state-of-the-art life cycle assessment theory and practices applied in the mining and mineral processing industries Includes in-depth, practical case studies outlined with life cycle assessment results to show future pathways for sustainability enhancement Provides fundamental knowledge on how to measure sustainability metrics using life cycle assessment in mining industries

Life cycle assessment (LCA) is an established methodology used to quantify the environmental impacts of products, processes and services. Circular economy (CE) thinking is conceptual way of considering the impacts of consuming resources. By taking a closed loop approach, CE provides a framework for influencing behaviours and practices to minimise this impact. Development of the circular economy is a crucial component in the progression towards future sustainability. This book provides a robust systematic approach to the circular economy concept, using the established methodology of LCA. Including chapters on circular economic thinking, the use of LCA as a metric and linking LCA to the wider circular economy, this book utilises case studies to illustrate the approaches to LCA. With contributions from researchers worldwide, Life Cycle Assessment provides a practical, global guide for those who wish to use LCA as a research tool or to inform policy, process, and product improvement.

Life cycle assessment enables the identification of a broad range of potential environmental impacts occurring across the entire life of a product, from its design through to its eventual disposal or reuse. The need for life cycle assessment to inform environmental design within the built environment is critical, due to the complex range of materials and processes required to construct and manage our buildings and infrastructure systems. After outlining the framework for life cycle assessment, this book uses a range of case studies to demonstrate the innovative input-output-based hybrid approach for compiling a life cycle inventory. This approach enables a comprehensive analysis of a broad range of resource requirements and environmental outputs so that the potential environmental impacts of a building or infrastructure system can be ascertained. These case studies cover a range of elements that are part of the built environment, including a residential building, a commercial office building and a wind turbine, as well as individual building components such as a residential-scale photovoltaic system. Comprehensively introducing and demonstrating the uses and benefits of life cycle assessment for built environment projects, this book will show you how to assess the environmental performance of your clients' projects, to compare design options across their entire life and to identify opportunities for improving environmental performance.

How will we meet rising energy demands? What are our options? Are there viable long-term solutions for the future? Learn the fundamental physical, chemical and materials science at the heart of: • Renewable/non-renewable energy sources • Future transportation systems • Energy efficiency • Energy storage Whether you are a student taking an energy course or a newcomer to the field, this textbook will help you understand critical relationships between the environment, energy and sustainability. Leading experts provide comprehensive coverage of each topic, bringing together diverse subject matter by integrating theory with engaging insights. Each chapter includes helpful features to aid understanding, including a historical overview to provide context, suggested further reading and questions for discussion. Every subject is beautifully illustrated and brought to life with full color images and color-coded sections for easy browsing, making this a complete educational package. Fundamentals of Materials for Energy and Environmental Sustainability will enable today's scientists and educate future generations.

This book proposes an economic and environmental assessment tool to help private and public building designers and owners determine the global sustainability value of green buildings from a life cycle perspective. As it demonstrates, sustainable life cycle tools for building design and construction can help to achieve successfully integrated architecture. The first part of the book defines the relationship between environmental and economic aspects in a sustainable design approach and illustrates how life cycle methodologies, including Life Cycle Assessment and Life Cycle Costing, can be applied to life cycle design. Further, it highlights methods for calculating costs from LCA data, taking into consideration both discounted cash flow and external costs. In turn, the second part of the book presents an experimental design model, the Life Cycle Design Model (LCDM), which is based on a life cycle design approach that can be used to produce two different outcomes based on two assessment levels. The first assessment level involves creating a grid, called a Design Matrix, which is useful in the design process. The second assessment level involves drawing on LCA and LCC results to develop a user-friendly tool for designers and other actors involved in the building process so that they can assess the most sustainable design option using €CO, a factor that combines the environmental and energy effects of the building system with time and costs. Selected case studies illustrate the practical application of life cycle analysis and show how reflecting the environmental impacts and costs can improve the sustainability of buildings. The LCDM represents a transdisciplinary tool for the design team and, at the same time, allows information on users' needs and building performance to be communicated between experts and non-experts.

Life Cycle Inventory (LCI) Analysis is the second phase in the Life Cycle Assessment (LCA) framework. Since the first attempts to formalize life cycle assessment in the early 1970, life cycle inventory analysis has been a central part. Chapter 1, Introduction to Life Cycle Inventory Analysis, discusses the history of inventory analysis from the 1970s through SETAC and the ISO standard. In Chapter 2, Principles of Life

Cycle Inventory Modeling, the general principles of setting up an LCI model and LCI analysis are described by introducing the core LCI model and extensions that allow addressing reality better. Chapter 3, Development of Unit Process Datasets, shows that developing unit processes of high quality and transparency is not a trivial task, but is crucial for high-quality LCA studies. Chapter 4, Multi-functionality in Life Cycle Inventory Analysis: Approaches and Solutions, describes how multi-functional processes can be identified. In Chapter 5, Data Quality in Life Cycle Inventories, the quality of data gathered and used in LCI analysis is discussed. State-of-the-art indicators to assess data quality in LCA are described and the fitness for purpose concept is introduced. Chapter 6, Life Cycle Inventory Data and Databases, follows up on the topic of LCI data and provides a state-of-the-art description of LCI databases. It describes differences between foreground and background data, recommendations for starting a database, data exchange and quality assurance concepts for databases, as well as the scientific basis of LCI databases. Chapter 7, Algorithms of Life Cycle Inventory Analysis, provides the mathematical models underpinning the LCI. Since Heijungs and Suh (2002), this is the first time that this aspect of LCA has been fundamentally presented. In Chapter 8, Inventory Indicators in Life Cycle Assessment, the use of LCI data to create aggregated environmental and resource indicators is described. Such indicators include the cumulative energy demand and various water use indicators. Chapter 9, The Link Between Life Cycle Inventory Analysis and Life Cycle Impact Assessment, uses four examples to discuss the link between LCI analysis and LCIA. A clear and relevant link between these phases is crucial.

Assessing the Environmental Impact of Textiles and the Clothing Supply Chain, Second Edition, is a fully updated, practical guide on how to identify and respond to environmental challenges across the supply chain. This new edition features updates to important data on environmental impacts and their measurements, the sustainable use of water and electricity, and new legislation, standards and schemes. Chapters provide an introduction to the textile supply chain and an overview of the methods used to measure environmental impacts, including greenhouse gas emissions, water and energy footprints, and a lifecycle assessment (LCA) on environmental impacts. This book will be a standard reference for R&D managers in the textile industry and academic researchers in textile science. Provides a holistic view of the sustainability issues that affect the textile value chain Explains ways to calculate the textile industry’s use of resources, its impact on global warming, and the pollution and waste it generates Reviews key methods for the reduction of the environmental impact of textile products and how they are implemented in practice Includes methods for calculating product carbon footprints (PCFs), ecological footprints (EFs) and lifecycle assessments (LCA)

This first hands-on guide to ISO-compliant Life Cycle Assessment (LCA) makes this powerful tool immediately accessible to both professionals and students. Following a general introduction on the philosophy and purpose of LCA, the reader is taken through all the stages of a complete LCA analysis, with each step exemplified by real-life data from a major LCA project on beverage packaging. Measures as carbon and water footprint, based on the most recent international standards and definitions, are addressed. Written by two pioneers of LCA, this practical volume is targeted at first-time LCA users but equally makes a much-valued reference for more experienced practitioners. From the content: * Goal and Scope Definition * Life Cycle Inventory Analysis * Life Cycle Impact Assessment * Interpretation, Reporting and Critical Review * From LCA to Sustainability Assessment and more.

Investigative tools for analyzing environmental nanoparticles with health impactsBasic theories and models of life cycle analysis applied to nanomaterialsConnects LCA, detection technologies and sustainability This book addresses the ways life cycle assessment (LCA) concepts can be applied to analyze the fate of nanoparticles in a variety of environmental and manufacturing settings. After introducing LCA theory and modeling concepts, the work discusses risks associated with carbon nanotubes, graphene, silver, fullerenes, iron oxides and other particles generated by manufacturing or medical diagnostics. Chapters in the text discuss biomolecules and the application of in vivo biosensors. Also covered are fate analysis, risk assessment, toxicology and nanopathology with a focus on human health and disease.

Industrial ecology is a concept that has emerged in response to growing public concern about the impact of industry on the environment. In this framework the natural flow (or circulation) of materials and energy that takes place in biological ecosystems becomes a model for more efficient industrial "metabolism." What industrial ecology is and how it may be applied to corporate environmentalism are the subject of The Industrial Green Game. This volume examines industrial circulation of materials, energy efficiency strategies, "green" accounting, life-cycle analysis, and other approaches for preventing pollution and improving performance. Corporate leaders report firsthand on "green" efforts at Ciba-Geigy, Volvo, Kennecott, and Norsk Hydro. And an update is provided on the award-winning industrial symbiosis project in Kalundborg, Denmark. The Industrial Green Game looks at issues of special concern to business, such as measuring and shaping public perceptions and marketing "green" products to consumers. It offers discussions of the appropriate roles of government and private business.

Life-Cycle Assessment of Semiconductors presents the first and thus far only available transparent and complete life cycle assessment of semiconductor devices. A lack of reliable semiconductor LCA data has been a major challenge to evaluation of the potential environmental benefits of information technologies (IT). The analysis and results presented in this book will allow a higher degree of confidence and certainty in decisions concerning the use of IT in efforts to reduce climate change and other environmental effects. Coverage includes but is not limited to semiconductor manufacturing trends by product type and geography, unique coverage of life-cycle assessment, with a focus on uncertainty and sensitivity analysis of energy and global warming missions for CMOS logic devices, life cycle assessment of flash memory and life cycle assessment of DRAM. The information and conclusions discussed here will be highly relevant and useful to individuals and institutions.

This book compiles and critically discusses modern engineering system degradation models and their impact on engineering decisions. In particular, the authors focus on modeling the uncertain nature of degradation considering both conceptual discussions and formal mathematical formulations. It also describes the basics concepts and the various modeling aspects of life-cycle analysis (LCA). It highlights the role of degradation in LCA and defines optimum design and operation parameters. Given the relationship between operational decisions and the performance of the system’s condition over time, maintenance models are also discussed. The concepts and models presented have applications in a large variety of engineering fields such as Civil, Environmental, Industrial, Electrical and Mechanical engineering. However, special emphasis is given to problems related to large infrastructure systems. The book is intended to be used both as a reference resource for researchers and practitioners and as an academic text for courses related to risk and reliability, infrastructure performance modeling and life-cycle assessment.

Historically, regulations governing chemical use have often focused on widely used chemicals and acute human health effects of exposure to them, as well as their potential to cause cancer and other adverse health effects. As scientific knowledge has expanded there has been an increased awareness of the mechanisms through which chemicals may exert harmful effects on human health, as well as their effects on other species and ecosystems. Identification of high-priority chemicals and other chemicals of concern has prompted a growing number of state and local governments, as well as major companies, to take steps beyond existing hazardous chemical federal legislation. Interest in approaches and policies that ensure that any new substances substituted for chemicals of concern are assessed as carefully and thoroughly as possible has also burgeoned. The overarching goal of these approaches is to avoid regrettable substitutions, which occur when a toxic chemical is replaced by another chemical that later proved unsuitable because of persistence, bioaccumulation, toxicity, or other concerns. Chemical alternative assessments are tools designed to facilitate consideration of these factors to assist stakeholders in identifying chemicals that may have the greatest likelihood of harm to human and ecological health, and to provide guidance on how the industry may develop and adopt safer alternatives. A Framework to Guide Selection of Chemical Alternatives develops and demonstrates a decision framework for

evaluating potentially safer substitute chemicals as primarily determined by human health and ecological risks. This new framework is informed by previous efforts by regulatory agencies, academic institutions, and others to develop alternative assessment frameworks that could be operationalized. In addition to hazard assessments, the framework incorporates steps for life-cycle thinking - which considers possible impacts of a chemical at all stages including production, use, and disposal - as well as steps for performance and economic assessments. The report also highlights how modern information sources such as computational modeling can supplement traditional toxicology data in the assessment process. This new framework allows the evaluation of the full range of benefits and shortcomings of substitutes, and examination of tradeoffs between these risks and factors such as product functionality, product efficacy, process safety, and resource use. Through case studies, this report demonstrates how different users in contrasting decision contexts with diverse priorities can apply the framework. This report will be an essential resource to the chemical industry, environmentalists, ecologists, and state and local governments.

Life Cycle assessment (LCA) is a tool for environmental decision-support in relation to products from the cradle to the grave. Until now, more emphasis has been put on the inclusion quantitative models and databases and on the design of guidebooks for applying LCA than on the integrative aspect of combining these models and data. This is a remarkable thing, since LCA in practice deals with thousands of quantitative data items that have to be combined in the correct manner. For this, one needs mathematical rules and algorithmic principles for carrying out an LCA. This book presents the first coherent treatment of the mathematical and algorithmic aspects of LCA. These computational aspects are presented in matrix form, so that a concise and elegant formulation is achieved. This form, moreover, provides a platform for further extension of analysis using perturbation theory, structural theory and economic input-output analysis.

Life Cycle Assessment addresses the dynamic and dialectic of building and ecology, presenting the key theories and techniques surrounding the use of life cycle assessment data and methods. Architects and construction professionals must assume greater responsibility in helping building owners to understand the implications of making material, manufacturing, and assemblage decisions and therefore design to accommodate more ecological building. Life Cycle Assessment is a guide for architects, engineers, and builders, presenting the principles and art of performing life cycle impact assessments of materials and whole buildings, including the need to define meaningful goals and objectives and critically evaluate analysis assumptions. As part of the PocketArchitecture Series, the book includes both fundamentals and advanced topics. The book is primarily focused on arming the design and construction professional with the tools necessary to make design decisions regarding life cycle, reuse, and sustainability. As such, the book is a practical text on the concepts and applications of life cycle techniques and environmental impact evaluation in architecture and is presented in language and depth appropriate for building industry professionals.

This book is a uniquely pedagogical while still comprehensive state-of-the-art description of LCA-methodology and its broad range of applications. The five parts of the book conveniently provide: I) the history and context of Life Cycle Assessment (LCA) with its central role as quantitative and scientifically-based tool supporting society’s transitioning towards a sustainable economy; II) all there is to know about LCA methodology illustrated by a red-thread example which evolves as the reader advances; III) a wealth of information on a broad range of LCA applications with dedicated chapters on policy development, prospective LCA, life cycle management, waste, energy, construction and building, nanotechnology, agrifood, transport, and LCA-related concepts such as footprinting, ecolabelling,design for environment, and cradle to cradle. IV) A cookbook giving the reader recipes for all the concrete actions needed to perform an LCA. V) An appendix with an LCA report template, a full example LCA report serving as inspiration for students who write their first LCA report, and a more detailed overview of existing LCIA methods and their similarities and differences.

In the quest to mitigate the buildup of greenhouse gases in Earth's atmosphere, researchers and policymakers have increasingly turned their attention to techniques for capturing greenhouse gases such as carbon dioxide and methane, either from the locations where they are emitted or directly from the atmosphere. Once captured, these gases can be stored or put to use. While both carbon storage and carbon utilization have costs, utilization offers the opportunity to recover some of the cost and even generate economic value. While current carbon utilization projects operate at a relatively small scale, some estimates suggest the market for waste carbon-derived products could grow to hundreds of billions of dollars within a few decades, utilizing several thousand teragrams of waste carbon gases per year. Gaseous Carbon Waste Streams Utilization: Status and Research Needs assesses research and development needs relevant to understanding and improving the commercial viability of waste carbon utilization technologies and defines a research agenda to address key challenges. The report is intended to help inform decision making surrounding the development and deployment of waste carbon utilization technologies under a variety of circumstances, whether motivated by a goal to improve processes for making carbon-based products, to generate revenue, or to achieve environmental goals.

Life Cycle Assessment

When Cleveland's Cuyahoga River caught fire in 1969, no environmental measurements were necessary to know the seriousness of the problem. Incidents like the Cuyahoga fire raise an important question: Can catastrophes-in-the-making be detected early enough to be prevented? For those in industry, such disasters point to the need for measures that can improve the environmental performance of processes, products, business practices, and linked industrial systems. In Measures of Environmental Performance and Ecosystem Condition, experts share their insights on environmental metrics. The volume explores the most productive relationship between measures of environmental performance and measures of ecosystem conditions. It reviews current approaches, evaluates structures for business decisionmaking, and includes a matrix for determining the environmental performance of industrial facilities. Case studies include: Development and application of a water-quality rating scheme for streams and reservoirs in the Tennessee Valley. Three years of successful experience with waste metrics at 3M. The book covers the range of environmental performance and condition metrics, from the use of material flow data to monitor environmental performance at the national level to the use of bioassays to measure the toxicity of industrial effluents. This book offers something for everyone--policymakers,

executives, engineers, managers, and advocates--with a stake in the measurement of environmental performance and ecological conditions.

This book develops a model to evaluate and assess life-cycle greenhouse gas emissions based on typical Australian commercial building design options. It also draws comparisons between some of the many green building rating tools that have been developed worldwide to support sustainable development. These include: the Leadership in Energy and Environmental Design (LEED(R)) by the United States Green Building Council (USGBC), Building Research Establishment Environmental Assessment Method (BREEAM) by the Building Research Establishment, Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) by the Japanese Sustainable Building Consortium, and Green Star Environmental Rating System by the Green Building Council of Australia. Life-cycle assessment (LCA), life-cycle energy consumption (LCE), and life-cycle greenhouse gas emissions (LGE) form the three pillars of life-cycle studies, which have been used to evaluate environmental impacts of building construction. Assessment of the life-cycle greenhouse gas emissions of buildings is of one of the significant obstacles in evaluating green building performance. This book explains the methodology for achieving points for the categories associated with reduction of greenhouse gas emissions in the Australian Green Star rating system. The model for the assessment uses GaBi 8.7 platform along with Visual Basic in Microsoft Excel and shows the relationship between the building's energy consumption and greenhouse gas emissions released during the lifetime of the building. The data gathered in the book also illustrates that the green building design and specifications are becoming more popular and are being increasingly utilised in Australia. This book is important reading for anyone interested in sustainable construction, green design and buildings and life cycle assessment tools.