

JOURNAL OF
INDUSTRIAL ECOLOGY

中文摘要
《产业生态学报》
第11卷第1期

Chinese Abstracts
Journal of Industrial Ecology
Volume 11, Number 1

翻译
王韬

Translated by
Tao Wang

《产业生态学报》

2007 年冬, 第 11 卷第 1 期, 11-30 页

题目: 产业共生“揭秘”

作者: Marian Chertow

关键字: 副产物集成, 生态产业开发, 生态产业园区, 产业生态学, 产业生态系统, 产业共生

摘要: 1989 年以来, 有关人员致力于研究产业共生、优化企业间的资源共享, 并力图复制和推广丹麦卡伦堡(Kalundborg)的自组织产业共生模式。这当中不乏成功的个案, 也积累了一些失败的教训。产业共生定义为多样化企业及企业群落间的物料、能量、水及副产物的系统交换与共享, 本文就其动机与方法作了一个历史性的回顾, 发现深究现存的产业共生模式比单纯设计与构建生态产业园区更有助于相关产业的长期可持续发展。

美国总统可持续发展委员会于 20 世纪 90 年代初倡议了 15 个产业共生项目, 引起了广泛的关注。文章分析了所有这些项目, 并与其它 12 个更具自组织特征的项目作了对比, 由此发现和认定了一些产业共生的“核心”要素。在产业共生的初始阶段应采取的一些特殊的政策与措施, 以促进大规模共生的发生与发展。作者最后总结指出, 以环境和经济为目的的共生行为广为存在, 关键是如何发掘和培养它们。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 11-30

“Uncovering” Industrial Symbiosis

Marian Chertow

KEYWORDS:

by-product synergy, eco-industrial development, eco-industrial parks, industrial ecology, industrial ecosystems, industrial symbiosis

SUMMARY:

Since 1989, efforts to understand the nature of interfirm resource sharing in the form of industrial symbiosis and to replicate in a deliberate way what was largely self-organizing in Kalundborg, Denmark have followed many paths, some with much success and some with very little. This article provides a historical view of the motivations and means for pursuing industrial symbiosis—defined to include physical exchanges of materials, energy, water, and by-products among diversified clusters of firms. It finds that “uncovering” existing symbioses has led to more sustainable industrial development than attempts to design and build eco-industrial parks incorporating physical exchanges.

By examining 15 proposed projects brought to national and international attention by the U.S. President’s Council on Sustainable Development beginning in the early 1990s, and contrasting these with another 12 projects observed to share more elements of self-organization, recommendations are offered to stimulate the identification and uncovering of already existing “kernels” of symbiosis. In addition, policies and practices are suggested to identify early-stage precursors of potentially larger symbioses that can be nurtured and developed further. The article concludes that environmentally and economically desirable symbiotic exchanges are all around us and now we must shift our gaze to find and foster them.

《产业生态学报》

2007年冬, 第11卷第1期, 31-42页

题目: 中国的产业共生: 以贵糖集团为例

作者: Qinghua Zhu, Ernest A. Lowe, Yuan-an Wei, Donald Barnes

关键字: 副产物交换, 生态产业联网, 生态产业园区(EIP), 产业生态系统, 制浆与造纸业, 制糖业

摘要: 作为中国名列前茅的制糖企业, 贵糖集团过去四十年来一直致力于企业内部及外部产业共生体系的开发。集团首先实现了下游所属企业对制糖业副产物的重复利用, 从而在改善产品质量的同时, 减少了污染排放与治污费用, 创造了可观的环境与经济效益。

贵糖所属的企业涉及糖、酒精、水泥、复合肥料、纸张等多种产品的生产, 为集团内部副产物的回收与再利用创造了良好的条件。放眼于外, 贵糖通过提供优质的产品建立了一个稳固的客户群; 通过一些技术与经济的激励扩展了原料供应农户和供应商; 对政府的政策变动, 集团的反应也越来越迅速。

贵糖迄今为止的经营之道很好地反映了产业共生的基本理念, 但风险莫测的全球化糖业市场提出了巨大的挑战, 集团任重而道远。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 31-42

Industrial Symbiosis in China: A Case Study of the Guitang Group

Qinghua Zhu, Ernest A. Lowe, Yuan-an Wei, and Donald Barnes

KEYWORDS:

by-product exchange, eco-industrial networking, eco-industrial park (EIP), industrial ecosystem, pulp and paper industry, sugar industry

SUMMARY:

The Guitang Group (GG), which operates one of China's largest sugar refineries, has been developing and implementing an internal and external industrial symbiosis strategy for more than four decades. The GG first invested in developing its own collection of downstream companies to utilize nearly all byproducts of sugar production. This strategy has generated new revenues and reduced environmental emissions and disposal costs, while simultaneously improving the quality of sugar.

Internally, the GG's complex consists of interlinked production of sugar, alcohol, cement, compound fertilizer, and paper and includes recycling and reuse. Externally, the GG has established a strong customer base as a result of its product quality, has worked to maintain and expand its supply base through technological and economic incentives to farmers (and even to competitors), and has had to react to a strong government presence that fundamentally affects its operations.

Operations to date support some of the fundamental concepts of industrial symbiosis. Significant challenges exist, though, if the company is to continue to prosper in the volatile globalized sugar market.

《产业生态学报》

2007 年冬, 第 11 卷第 1 期, 43-54 页

题目: 得克萨斯州回收、再制造与废物处理企业的闭路循环网络的地理格局分析

作者: Donald Lyons

关键字: 生态产业开发, 经济地理, 产业生态学, 产业生态系统, 产业共生, 物料流

摘要: 产业生态学体现了环境保护与发展的关键战略性理念, 其核心思想之一即实现废旧产品及废物在生产过程中的再利用以及物料的闭路循环。本文研究了美国得克萨斯州回收、再处理、再制造及废物管理经营 (RRWT) 企业的地理位置与物流情况, 由此分析了不同种类废物的闭路循环与地理尺度间的关系。结果表明闭路循环并没有一个统一的空间尺度要求, RRWT 企业在多级尺度上都普遍存在, 且运营得十分成功。物流循环的空间范围主要取决于废物的产生位置与回收再利用方式, 与 RRWT 企业的位置与空间格局联系不大; 亦即物流的闭路循环由相关 RRWT 业务的空间经济逻辑所决定。因此, 闭路循环不是一定区域内的 RRWT 企业所组成的单一物流交换网络, 不应限制在一个特定的地理尺度上。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 43-54

A Spatial Analysis of Loop Closing Among Recycling, Remanufacturing, and Waste Treatment Firms in Texas

Donald Lyons

KEYWORDS:

eco-industrial development, economic geography, industrial ecology, industrial ecosystem, industrial symbiosis, materials flows

SUMMARY:

Industrial ecology has emerged as a key strategy for improving environmental conditions. A central element of industrial ecology is the concept of closing the loop in material use (cycling) by directing used material and products (wastes) back to production processes. This article examines the issue of geographic scale and loop closing for heterogeneous wastes through an analysis of the location and material flows of a set of recycling, remanufacturing, recycling manufacturing, and waste treatment (RRWT) firms in Texas. The results suggest that there is no preferable scale at which loop closing should be organized. RRWT firms are ubiquitous and operate successfully throughout the settlement hierarchy. The cycling boundaries of RRWT firms are dependent primarily upon how and where their products are redirected to production processes rather than the firm's location in the settlement hierarchy. In other words, loop closing is dominated by the spatial economic logic of the transactions of the firm involved. These results suggest that we cannot assign loop closing to any particular spatial scale a priori nor can we conceive of closing the loop via RRWT firms in terms of monolithic networks bounded in space or place with internal material flows.

《产业生态学报》

2007年冬, 第11卷第1期, 55-72页

题目: 澳大利亚采矿业的产业共生: Kwinana 与 Gladstone 的案例分析

作者: Dick van Beers, Glen Corder, Alben Bossilkov, Rene van Berkel

关键字: 副产物集成, 生态产业开发, 产业生态学, 产业生态系统, 资源工业, 公用事业集成

摘要: 矿产工业区的物料集成是实现资源可持续加工的重要途径。本文以西澳大利亚的 Kwinana 和澳大利亚昆士兰的 Gladstone 这两个重工业地区为例, 分析了二者的产业集成发展之路, 研究了区域集成的动力、障碍及触发因素等问题。此外, 上述两个案例还与处于相同发展阶段的其它国家的著名产业共生案例作了比较。Kwinana 地区产业共生的数量、多样性、复杂度及成熟度十分引人注目。Gladstone 的特点则在于其土地的辽阔与工业类型的单一。两个区域在水资源、能源及无机废物的再利用方面都尚存许多共生机会。为了进一步发展产业共生, 澳大利亚资源可持续加工中心——一个由澳洲矿产企业、研究所和政府部门组成的联合机构——正在推进几项合作项目, 包括产业共生机会的认定与评价研究、研究成果的工业实践等等。文章介绍了上述项目的进展情况。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 55-72

Industrial Symbiosis in the Australian Minerals Industry: The Cases of Kwinana and Gladstone

Dick van Beers, Glen Corder, Alben Bossilkov, and Rene van Berkel

KEYWORDS:

by-product synergy, eco-industrial development, industrial ecology, industrial ecosystem, resource industry, utility synergy

SUMMARY:

The realization of regional synergies in industrial areas with intensive minerals processing provides a significant avenue toward sustainable resource processing. This article provides an overview of past and current synergy developments in two of Australia's major heavy industrial regions, Kwinana (Western Australia) and Gladstone (Queensland), and includes a comparative review and assessment of the drivers, barriers, and trigger events for regional synergies initiatives in both areas. Kwinana and Gladstone compare favorably with wellknown international examples in terms of the current level and maturity of industry involvement and collaboration and the commitment to further explore regional resource synergies. Kwinana stands out with regard to the number, diversity, complexity, and maturity of existing synergies. Gladstone is remarkable with regard to unusually large geographic boundaries and high dominance of one industry sector. Many diverse regional synergy opportunities still appear to exist in both industrial regions, mostly in three broad areas: water, energy, and inorganic by-product reuse. To enhance the further development of new regional synergies, the Centre for Sustainable Resource Processing, a joint initiative of Australian minerals processing companies, research providers, and government agencies, has undertaken several collaborative projects. These include research to facilitate the process of identifying and evaluating potential synergy opportunities and assistance for the industries with feasibility studies and implementation of selected synergy projects in both regions. The article also reports on the progress to date from this CSRP research.

《产业生态学报》

2007年冬, 第11卷第1期, 73-84页

题目: 产业生态学可以独立于可持续性之外吗?

作者: John R. Ehrenfeld

关键字: 适应性管理, 类比, 复杂性, 产业生态学, 隐喻, 可持续性

摘要: 产业生态学一直基于产业系统对自然生态的模拟, 在其15年左右的发展历程中, 人类对自然系统难以为继的忧虑逐渐加深, 可持续性日益成为全球的广泛共识。本文分析了产业生态学与可持续性之间的关系, 指出建立在经典生态学模型基础之上的产业生态学无法实现全面的可持续性, 因为经典的产业生态类比忽视了人类社会文化因素对可持续目标的重要影响。为了更全面更有效地解决可持续性的问题, 产业生态学必须重新建构在基于复杂性理论的更新的生态系统模型之上。相比机械的经济学模型, 生命系统的复杂性模型能够更好的描述可持续发展的涌现特性。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 73-84

Would Industrial Ecology Exist without Sustainability?

John R. Ehrenfeld

KEYWORDS:

adaptive management, analogy, complexity, industrial ecology, metaphor, sustainability

SUMMARY:

Industrial ecology rests historically (even in a short lifetime of 15 years or so) on the metaphorical power of natural ecosystems. Its evolution parallels the rise of concerns over unsustainability, that is, the threats to our world's ability to support human life, and the emergence of sustainability as a normative goal on a global scale. This article examines the relationships between industrial ecology and sustainability and argues that, in its historical relationship to classical ecology models, the field lacks power to address the full range of goals of sustainability, however defined. The classical ecosystem analogy omits aspects of human social and cultural life central to sustainability. But by moving beyond this model to more recent ecosystem models based on complexity theory, the field can expand its purview to address sustainability more broadly and powerfully. Complexity models of living systems can also ground alternative normative models for sustainability as an emergent property rather than the output of a mechanistic economic model for society's workings.

《产业生态学报》

2007年冬, 第11卷第1期, 85-102页

题目: 氟元素生产、使用及流失的核算

作者: Gara Villalba, Robert U. Ayres, Hans Schroder

关键字: 氟循环, 氟排放, 产业生态学, 物料流分析(MFA), 资源核算, 物质流分析(SFA)

摘要: 氟元素对人类健康及化学工业都有着重大的影响。尽管我们长期依赖氟及氟化物, 却并不知道如何明智地使用这类产品。氟的工业应用已历百年, 造成了一些严重的后果, 如炼铝过程的氢氟酸污染、大量使用氯氟烃(CFC)导致的臭氧层损耗等。目前的研究多侧重于氯氟烃、氢氟烃(HFCs)及六氟化硫(SF₆)等化合物的温室效应。本文另辟蹊径, 指出氟是一种不可再生且多数情况下难以替代的资源。文章从氟矿资源出发, 对氟的加工乃至广为存在的耗散型使用过程作了跟踪分析, 建立了氟系统的存量与流量模型, 并以此模型为基础提出了一些有助于提高氟回收率的措施。如磷酸盐产业是氟石的重要来源之一, 但磷石膏废物的排放也造成了严重的氟流失, 这应是改进氟系统效率的一个关键环节。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 85-102

Accounting for Fluorine: Production, Use, and Loss

Gara Villalba, Robert U. Ayres, and Hans Schroder

KEYWORDS:

fluorine cycle, fluorine emissions, industrial ecology, materials flow analysis (MFA), resource accounting, substance flow analysis (SFA)

SUMMARY:

Fluorine is an essential element to human health and to the chemical industry. In spite of our dependence on fluorine and fluorine compounds, we have yet to learn to use them wisely. Our fluorine history, which spans about a hundred years, has had negative effects such as hydrofluoric acid pollution caused by aluminum smelters and ozone depletion due to chlorofluorocarbon (CFC) emissions. More recent concerns center on greenhouse effects from CFCs, hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF₆). In this article we note also that fluorine is a nonrenewable resource that is nonsubstitutable for many purposes. This article tracks fluorine from sources through conversion processes to end uses, most of which are dissipative. We present a stock-flow model of the fluorine system. Based on this model we consider some possible measures that could be taken to increase the degree of recovery. To mention one example, a large percentage of the world demand for fluorspar could be supplied by the phosphate rock (fertilizer) industry, which currently dissipates a great deal of recoverable fluorine in waste phospho-gypsum.

《产业生态学报》

2007 年冬, 第 11 卷第 1 期, 103-120 页

题目: 1990 至 2003 年间芬兰能源系统的氮磷循环

作者: Laura Saikku, Riina Antikainen, Pekka E. Kauppi

关键字: ImPACT 模型, 产业生态学, IPAT 方程, 氮氧化物 (NO_x) 排放, 泥煤燃烧, 物质流分析 (SFA)

摘要: 能源生产往往造成氮、磷等营养元素从地质及生物系统向土壤、水和大气圈的转移与释放。芬兰的泥煤消费是推动氮、磷元素由自然流向经济系统的重要动力。本文通过局部物质流分析对芬兰能源系统的氮、磷物流作了量化, 并采用 ImPACT 模型分析了氮氧化物排放的驱动因素。

2000 年芬兰共有 140 千吨的氮主要伴随石煤和硬质煤流入能源系统, 其中约 66 千吨以氮氧化物和一氧化二氮的形式释放出来, 另外 74 千吨则转化为氮气。上述排放多发生在交通运输过程。此外, 约 6 千吨磷随着石煤与木柴进入芬兰能源系统, 因为燃烧后的灰渣主要用于建筑业或进行填埋处理, 返回自然界的磷元素数量甚微。

20 世纪的燃料消耗导致氮元素的流入增长了 20 倍, 磷流入也增长了 8 倍。1900 至 1950 年, 硬质煤消费的增长引起了氮流的缓慢增长。1970 年以来木柴的消费显著增长, 是磷流增长的原因之一。氮氧化物的排放到 20 世纪 80 年代转趋稳定, 随后由于技术的进步 (如能源企业的脱氮技术、汽车催化转化技术等) 而日益下降。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 103-120

Nitrogen and Phosphorus in the Finnish Energy System, 1900-2003

Laura Saikku, Riina Antikainen, and Pekka E. Kauppi

KEYWORDS:

ImPACT model, industrial ecology, IPAT, nitrogen oxides (NO_x) emissions, peat combustion, substance flow analysis (SFA)

SUMMARY:

In producing power, humans move the nutrients nitrogen (N) and phosphorus (P) from their long-term geological and biological stocks and release or emit them in soil, water, and the atmosphere. In Finland, peat combustion is an important driver of N and P fluxes from the environment to human economy. The flows of N and P in the Finnish energy system were quantified with partial substance flow analysis, and the driving forces of emissions of nitrogen oxides (NO_x) were analyzed using the ImPACT model.

In the year 2000 in Finland, 140,000 tonnes of nitrogen¹ entered the energy system, mainly in peat and hard coal. Combustion released an estimated 66,000 tonnes of N as nitrogen oxides (NO_x) and nitrous oxides (N₂O) and another 74,000 tonnes as elemental N₂. Most of the emissions were borne in traffic. At the same time, 6,000 tonnes of P was estimated to enter the Finnish energy system, mostly in peat and wood. Ash was mainly used in earth construction and disposed in landfills; thus negligible levels of P were recycled back to nature.

During the twentieth century, fuel-borne input of N increased 20-fold, and of P 8-fold. In 1900-1950, the increasing use of hard coal slowly boosted N input, whereas wood fuels were the main carrier of P. Since 1970, the fluxes have been on the rise. NO_x emissions leveled off in the 1980s, though, and then declined in conjunction with improvements in combustion technologies such as NO_x removal (de-NO_x) technologies in energy production and catalytic converters in cars.

《产业生态学报》

2007 年冬, 第 11 卷第 1 期, 121-140 页

题目: 中国——一个发展中大国的物质流状况与经济增长

作者: Ming Xu, Tianzhu Zhang

关键字: 中国, 经济系统的物质流核算与分析(EW-MFA), 产业生态学, 产业代谢, 资源使用指标, 可持续发展

摘要: 可持续发展兼顾自然环境与人类社会和经济系统。经济系统的物质流核算与分析(EW-MFA)是研究经济体实物特征的国际公认的方法。许多工业化国家已开展了 EW-MFA 研究; 但中国在这方面刚刚起步, 本文即相关的最初尝试之一。文章编纂了 1990 至 2002 年间的中国物质流账户, 提出了一些物质流指标, 并与它国做了比较。除 1998 年有所下降之外, 12 年来中国的总物流消耗一直保持增长, 国家八五、九五及十五三个阶段的物质流效率表现则各有不同。基于此一研究, 作者提出了一些 EW-MFA 方法的改进建议。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 121-140

Materials Flow and Economic Growth in Developing China

Ming Xu and Tianzhu Zhang

KEYWORDS:

China, economy-wide material flow accounting and analysis (EW-MFA), industrial ecology, industrial metabolism, resource use indicators, sustainable development

SUMMARY:

The concept of sustainable development concerns not only the natural environment but also human societies and economies. The method of economy-wide material flow accounting and analysis (EW-MFA) is internationally recognized as a valuable tool for studying the physical dimensions of economies. EW-MFA has been carried out in many industrialized countries, but very little work has been done for developing China; this article can be regarded as one of the first attempts to study China's economy in terms of material flows. In this article we have compiled material flow accounts for China during the time series 1990 to 2002 and derived indicators associated with international comparison. Results show that the amount of material consumption of China's economy increased except for a slump around 1998, whereas the material efficiency represented a three-phase trend reflecting different macropolicies of the Eighth, Ninth, and Tenth Five-Year Plans implemented by the central government. Based on this experience with EW-MFA for China, suggestions for methodology development and further research are given for improving EW-MFA as a more effective tool for environmental management.

《产业生态学报》

2007 年冬, 第 11 卷第 1 期, 141-160 页

题目: 社会情境下的物料流: 一个结合物料流分析与情境脉络行为分析的越南案例

作者: Marieke Hobbes, Serge I. P. Stalpers, Jiska Kooijman, Thi Thu Thanh Le, Khanh Chi Trinh, Thi Anh Dao Phan

关键字: 情境脉络行为, 基于行为者的分析, 产业生态学, 物料流分析(MFA), 刀耕火种, 越南

摘要: 物料流分析(MFA)是产业生态学的重大成就之一。超越单纯的核算, 研究物料流的社会背景, 有助于促进MFA的进一步发展。这一社会扩展MFA分析可在不同级别上展开。本文将特定物料流与导致这些物流的行为者与行为机理联系起来, 通过一个情境脉络行为(AiC)分析框架, 对直接及间接的行为者与作用因素做了分析。研究选点在越南北部山谷中的一个名为Tat hamlet的稻谷产地, 侧重分析了与该地区基本需求和可持续发展最为相关的一些物料流。影响这些物流的行为者主要包括农户、政府官员、经销商及农业企业, 其中尤为重要是政府官员。将MFA与基于行为者的社会分析法结合起来意义重大: 前者对实物系统作出了定量的平衡核算, 确定了一些关键过程; 后者则揭示了影响这些过程的社会机制, 从而为决策者确定关键的行为人、做出决策和改进提供了依据。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 141-160

Material Flows in a Social Context: A Vietnamese Case Study Combining the Materials Flow Analysis and Action-in-Context Frameworks

Marieke Hobbes, Serge I. P. Stalpers, Jiska Kooijman, Thi Thu Thanh Le, Khanh Chi Trinh, and Thi Anh Dao Phan

KEYWORDS:

action-in-context, actor-based analysis, industrial ecology, materials flow analysis (MFA), swidden agriculture, Vietnam

SUMMARY:

Materials flow analysis (MFA) is one of the central achievements of industrial ecology. One direction in which one can move MFA beyond mere accounting is putting the material flows in their social context. This "socially extended MFA" may be carried out on various levels of aggregation. In this article, specific material flows will be linked to concrete actors and mechanisms that cause these flows, using the action-in-context (AiC) framework, which contains, inter alia, both proximate and indirect actors and factors. The case study site is of Tat hamlet in Vietnam, set in a landscape of paddy fields on valley floors surrounded by steep, previously forested slopes. Out of the aggregate MFA of Tat, the study focuses on material flows associated with basic needs and sustainability. The most important actors causing these material flows are farming households, politicians, traders, and agribusiness firms, of which local politicians turned out to be pivotal. The study shows the surplus value of combining MFA with actor-based social analysis. MFA achieves the balanced quantification of the physical system, thus helping to pinpoint key processes. Actor-based analysis adds the causal understanding of what drives these key processes, leading to improved scenarios of the future and effective identification of target groups and instruments for policy making.

《产业生态学报》

2007 年冬, 第 11 卷第 1 期, 161-180 页

题目: 关于生命周期评价的不确定性的刻画、传递与分析的一项定量调查

作者: Shannon M. Lloyd, Robert Ries

关键字: 误差分析, 误差传递, 产业生态学, 建模, 模拟, 可
变性

摘要: 生命周期评价(LCA)可用于模拟和量化生产系统的资源消耗、环境排放乃至环境及健康方面的影响。这一过程多如下展开: LCA 专家定义模型结构, 赋予模型参数一个确定值, 随后通过确定性模型算出可能的环境影响; 其失误之处在于没有考虑 LCA 方法的内在的可变性与不确定性。决策者作出理想的决策必须掌握不同系统 LCA 分析的不确定之处与分歧所在。本文提出并试验了几种 LCA 的不确定分析方法, 如蒙特卡洛法和模糊集分析法等。上述方法在定量化决策分析中十分常用, 但也无法保证结果的高度可靠。为此, 作者对各类 LCA 的不确定方法作了调查, 分析了每种方法的结果可靠程度及其对决策的帮助, 指出了一些方法的缺陷, 并就如何改进 LCA 的不确定性分析作了讨论。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 161-180

Characterizing, Propagating, and Analyzing Uncertainty in Life-Cycle Assessment: A Survey of Quantitative Approaches

Shannon M. Lloyd and Robert Ries

KEYWORDS:

error analysis, error propagation, industrial ecology, modeling, simulation, variability

SUMMARY:

Life-cycle assessment (LCA) practitioners build models to quantify resource consumption, environmental releases, and potential environmental and human health impacts of product systems. Most often, practitioners define a model structure, assign a single value to each parameter, and build deterministic models to approximate environmental outcomes. This approach fails to capture the variability and uncertainty inherent in LCA. To make good decisions, decision makers need to understand the uncertainty in and divergence between LCA outcomes for different product systems. Several approaches for conducting LCA under uncertainty have been proposed and implemented. For example, Monte Carlo simulation and fuzzy set theory have been applied in a limited number of LCA studies. These approaches are well understood and are generally accepted in quantitative decision analysis. But they do not guarantee reliable outcomes. A survey of approaches used to incorporate quantitative uncertainty analysis into LCA is presented. The suitability of each approach for providing reliable outcomes and enabling better decisions is discussed. Approaches that may lead to overconfident or unreliable results are discussed and guidance for improving uncertainty analysis in LCA is provided.

《产业生态学报》

2007 年冬, 第 11 卷第 1 期, 181-200 页

题目: 生物垃圾的生命周期评价模型: 厨房与庭院生物垃圾的计算

作者: Sonja Schmidt, Claudia Pahl-Wostl

关键字: 花园垃圾, 产业生态学, 有机废物, 废物收集, 废物管理, 庭院垃圾

摘要: 居民的厨房与庭院会产生大量的生物垃圾。本文介绍了一种以生命周期评价(LCA)为基础的估算上述生物垃圾重量的综合方法, 有助于实现生物垃圾的综合管理。文章不但定义了方法的相关操作基数、前提假设及估算法则, 还分析了估算垃圾生成量过程中的空间位置与范围不确定的问题。计算时需获取如下信息: (1)家庭内部用于堆肥的生物物质质量, (2)剩余废物中的有机质含量, (3)带回系统收集的生物垃圾量, (4)路边回收系统收集的生物垃圾量。该模型的基本单位是千克/(人·年), 还包括了一些以前未加考虑的生物垃圾处理方法: 如 LCA 评价区分了私人与公共垃圾运输方式所造成的不同生态影响, 对家庭内部堆肥处理和收集系统收集处理两种路径下的环境影响也作了估计。文章重在比较不同区域的不同生物垃圾收集手段, 同时分析了相关操作基数的灵敏度, 研究了家庭行为的影响。这一方法正逐步成为生物垃圾的 LCA 管理方法之一。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 181-200

Modeling Biowaste Flows for Life-Cycle Assessment: Calculation of the Potential and Collected Weight of Kitchen and Garden Waste

Sonja Schmidt and Claudia Pahl-Wostl

KEYWORDS:

garden waste, industrial ecology, organic waste, waste collection, waste management, yard waste

SUMMARY:

This article presents an integrative approach to calculating the weight of potential biowaste and collected biowaste materials, as the basis for a life-cycle assessment (LCA) of biowaste management. Biowaste contains kitchen and garden (yard) waste of households. This approach could be used for waste management planning and for the implementation of biowaste schemes. Case studies and examples in the literature are analyzed to model the mass flow of biowaste. This article defines relevant operands, presents the main assumptions, and describes the calculation principles. Spatial aspects and the uncertainties related to the inclusion of this aspect are explicitly considered in the calculation of the weight of the potential biowaste. We also present the calculation principles for obtaining the weight of (1) biowaste used in home composting, (2) the organic portion of residual waste, (3) biowaste separately collected by a bring system, and (4) biowaste separately collected by curbside collection (known in some areas as curbside collection). By choosing the biowaste potential in kilograms per capita year (kg/cap yr) as the functional unit, previously ignored options within the biowaste system could be assessed. For example, widening the system boundaries allows LCA studies to assess the contribution of private and public transport of waste to ecological impact categories. It allows examining the effects of supporting home composting through financial incentives and the introduction of a separate collection system. This study focuses on the comparison of different collection types and on the characteristics of the area under investigation. It also incorporates the behavior of the inhabitants of households and includes a sensitivity analysis of relevant operands. This approach is being included in an LCA assessing biowaste management options.

《产业生态学报》

2007 年冬, 第 11 卷第 1 期, 201-216 页

题目: “绿色认证”木制品的市场开发: 建筑材料供应链的绿色化

作者: Lloyd C. Irland

关键字: 环境友好型木制品, 林业管理委员会, 绿色认证, 产业生态学, LEED(能源与环境设计先锋评估体系), 可持续林业倡议

摘要: 全世界都在推动建筑的绿色化。在设计层面上, 一些评估体系如 LEED 提出了建筑材料的环境标准, 以激励建筑设计与所有者采用更加“绿色”的建材。以森林产品为例, 与之相关的林业绿色认证有多种, 世界上越来越多的森林正在得到认证, 但绿色建筑的设计商及绿色家具的用户仍然不易买到经过认证的木制品。

目前许多经过绿色认证的林场的木制品在最终销售时并为加上认证的标识, 认证木材的市场推广还存在着超乎预料的困难。本文分析了这些困难的来源, 并提出了一些解决办法。木制品的供应链多头且复杂, 具有绿色认证标志的产品在进入用户手中之前必须得到各个生产与分销环节的支持。

文章还分析了购买批次与数量、产品的选择标准及价格弹性等影响因素, 评判了各种提高绿色认证建材产品的市场占有率的方法和措施, 并给出了建议。

Journal of Industrial Ecology

2007, Vol. 11, Issue 1, pp. 201-216

Developing Markets for “Green Certified” Wood Products: Greening the Supply Chain for Construction Materials

Lloyd C. Irland

KEYWORDS:

environmentally preferable wood products, Forest Stewardship Council, green certification, industrial ecology, LEED (Leadership in Energy and Environmental Design), Sustainable Forestry Initiative

SUMMARY:

A growing worldwide movement is seeking to promote the greening of the construction sector. At the design level, proponents of frameworks such as LEED (Leadership in Energy and Environmental Design) seek to motivate designers and building owners to employ environmentally desirable materials. A prominent component of this approach is boosting availability of “green” building materials through programs that will certify to buyers that materials meet environmental standards. For wood products, this has resulted in several forms of “green certification” for forest management. Increasingly large areas of forest are now being certified worldwide. Yet it remains difficult for designers of green buildings, or consumers seeking green furniture, to obtain certified wood products.

Many, if not most, of the logs now being harvested on green certified forest land worldwide are not reaching the store shelf with a certified label. Marketing certified wood all the way to the retail shelf has proved to be much harder than initially thought by proponents of certified products. This article explains the sources of these difficulties and outlines an approach to identifying products with high potential for marketing as certified products. Because of complex, multilevel supply chains for many wood products, support is required at all processing and distribution levels for a product to reach the retail customer with its green label.

Market participants’ purchase size and frequency, basis for product selection, buying influences, and price sensitivity are evaluated to identify product and market approaches likely to increase success rates for certified wood products. The article concludes with recommendations for expanding markets for green building materials.